ILLUMINATING ENGINEERING

OCTOBER 1955

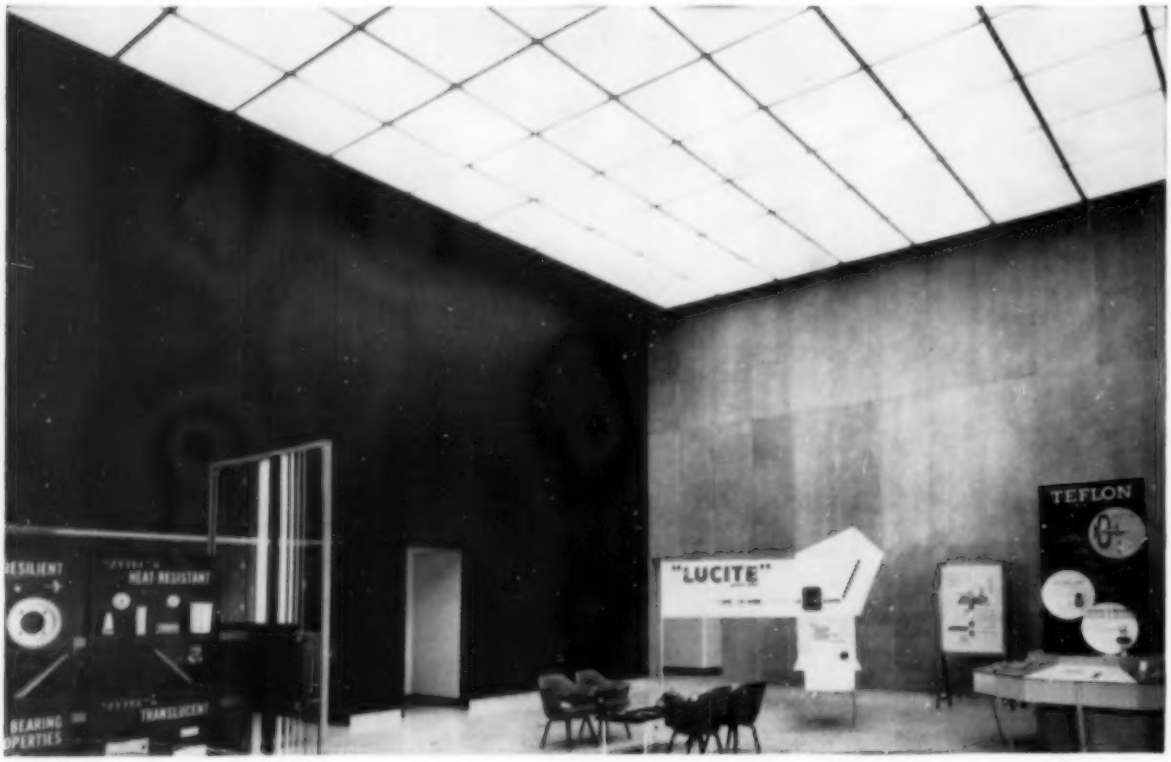
◆

Daylighting in Schools
Lighting Pictures in Residences
Emergency Power for F-Lamps
and Lighting Applications

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

WAKEFIELD GEOMETRICS

Another Installation



DuPont Lights Sales-Service Laboratory with Massed Beta Units

This beautiful room in the new E. I. duPont de Nemours and Company building near Wilmington, Delaware, is a showcase for duPont plastic products. And can you imagine a showcase more effectively lighted than this one with its massing of Wakefield Beta units?

Here again we see the great design freedom open to the illuminating engineer who specifies Wakefield Geometrics. Beta units come in four sizes—1′x4′, 2′x4′, 4′x4′ and 2′x2′—and may be combined in innumerable patterns, continuous or non-continuous.

Write for a catalog describing and illustrating the Wakefield Beta and other Wakefield Geometrics.

Beta units with **Rigid-Arch** diffusers are quickly installed and readily accessible for maintenance. They are framed in aluminum and have a Touch-Latch for easy accessibility.

THE WAKEFIELD COMPANY
VERMILION, OHIO

WAKEFIELD LIGHTING LIMITED
LONDON, ONTARIO

30% lower price

New Westinghouse slimline lead-lag ballast, with UI design

Exclusive UI core design brings you double benefits. First, price has been reduced approximately 30%, giving even greater lead-lag economy—no lamp replacement guesswork—longer ballast life. Second, new design means more ballast for your money for these reasons: *Quiet*—fewer lamination joints minimize vibration. *More efficient*—new core design and clamping method reduce iron losses. *Cooler*—electrical losses are reduced and heat is distributed more evenly.

See your nearby Westinghouse representative for complete details, or write Westinghouse Electric Corporation, Lighting Division, Edgewater Park, Cleveland, Ohio. J-04585

YOU CAN BE SURE...IF IT'S

Westinghouse

CONTINUING LEADERSHIP

Starring **RS-240-260** Ballast

for two 40-Watt Rapid-Start lamps on 240-280-Volt circuits with a nominal rating of 265 Volts.

High Power Factor, of course. And it's CBM-Certified to meet the requirements of Supplement 2 to ASA Specification C82.1.

RS-240-260
8⅜" x 2⅛" x 2"
Mounting Length 8⅜"
Weight 5.3 pounds

Starring Ballasts are Engineered into Leadership

Ask for our Complete Catalog

STARRING & COMPANY, INC.

1600 SEAVIEW AVENUE • BRIDGEPORT 8, CONNECTICUT

EDison 4-0108

ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

October
1955

Vol. L, No. 10

1955-1956 Officers

President
R. F. Hartenstein

Vice-President
M. N. Waterman

Vice-President
Kirk M. Reid

General Secretary
George J. Taylor

Treasurer
J. S. Schuchert

•

Editor
Ruby Redford

Advertising Manager
Clayton E. Ellis

•

Publications Committee

J. S. Schuchert, Chairman
R. M. Zabel
J. A. Schneller
John Ronayne
H. G. Clum
G. T. Anderson
A. M. Page

•

Executive Secretary
A. D. Hinckley

Technical Director
C. L. Crouch

Contents

459 Robert R. Hartenstein, I.E.S. President, 1955-1956

460 "Stand-Out" Lighting Characterizes Martin's Delicatessen

462 Willard Allphin — Daylight Measurement in Six New England Schools

471 I.E.S. Lighting Data Sheet — Series XX
Floodlighting a Building and Sidewalk (24-27)

473 Charles K. Champlin — Functional Lighting from a Working Model

475 I.E.S. Lighting Data Sheet — Series XX
Lighting a Board Room (13-78)

477 Albert B. Tollefsen and H. E. West — Characteristics of Power Supplies for Emergency Fluorescent Lighting

479 Brightness and Illumination by Interreflections in Enclosures — Discussion

483 F. H. Logan — New Approach to Roof Design for School Daylighting

485 I.E.S. Home Lighting Data Sheet
Cove Lighting in a Two-Wall Kitchen (22-48)

497 Eve Freyer — Methods of Lighting Pictures in Residences

504 Bank Lighting — With a Premium

505 Quality and Quantity of Interior Illumination — Discussion

509 I.E.S. Lighting Data Sheet — Series XX
Lighting a Furniture Store (12-96)

511 Questions and Answers on Light Sources

513 I.E.S. National and Local Officers

Also: Re-Lighting for the Latest Model, 470; Lighting for Seeing in the Dark, 474

5A TELECAST — Lighting News of Current Interest
Lighting Calendar, 9A; About People, 22A; Obituaries, 10A; Books and Pamphlets, 25A

28A Index to Advertisers

Sustaining Members — For latest listing see September ILLUMINATING ENGINEERING

STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.

ILLUMINATING ENGINEERING SOCIETY

EDITORIAL and advertising offices
1860 Broadway, New York 23, N. Y.

PUBLICATION office 32d Street & Elm Avenue, Baltimore 11, Md.

Founded 1906

ILLUMINATING ENGINEERING: The Journal of the Illuminating Engineering Society. Copyright 1955 by the Illuminating Engineering Society. Published monthly in the United States of America. Entered as second-class matter at the Post Office, Baltimore, Md. Acceptance for mailing at special postage rates provided for in Section 1103 P.L.&R., Act of October 3, 1917. Authorized July 16, 1918. ¶ Subscription $12 per year plus extra postage to all countries to which second-class postage rates do not apply; single copies $1.00. ¶ Address changes must be received at I.E.S. headquarters by the first of the month to be effective with the issue of the next succeeding month.

these A B C's* *are not so simple....*

PHYSICS LABORATORY
CASE INSTITUTE
CLEVELAND,
OHIO

*Appropriate Brightness Control

Here is lighting that does more than provide light. These A B C's provide proper levels of appropriately controlled brightness by utilizing more than a half century of illuminating engineering experience, distinctive design, and skilled manufacture.

The low-brightness troffers used to provide optimum seeing conditions in the physics laboratory of the Case Institute utilize these Curtis A B C's. The reflectors of Alzak Aluminum, processed after forming in the newly constructed Curtis Alzaking plant, are but one of many Curtis features that assure the Case Institute countless years of highly efficient illumination at low operating and maintenance costs.

Write Dept. K41-C1 for literature on this and other Curtis luminaires.

CURTIS
LIGHTING, INC.

CURTIS LIGHTING, INC.
6135 West 65th Street
Chicago 38, Illinois

IN CANADA
Curtis Lighting of Canada, Ltd.
195 Wickstead Ave.
Leaside, Toronto 17, Ont., Canada

NAME_____ ADDRESS_____ CITY_____ STATE_____

Robert F. Hartenstein, President — 1955-1956

Illuminating Engineering Society

TRADITIONALLY, this page in the October issue is given over to a biographical sketch and introduction of the incoming President of I.E.S. Such introduction is scarcely needed for Robert F. Hartenstein, the Society's current leader. Everybody knows Bob Hartenstein — or knows of him—and of his tremendous energy and leadership qualities.

Mr. Hartenstein has held no less than six national elective positions in I.E.S., probably a record, and has been assigned to numerous committee activities, most of them as chairman. Even prior to his election to Council, as Chairman of the National Technical Conference Committee for three years, he became an especially well-known I.E.S. personality all over the country. Mr. Hartenstein's service to I.E.S. dates back to 1925. Following his acceptance as a member, he lost no time in plunging into active Society work, including Local Representative for Akron, Ohio, and later as Chairman of the Cleveland Section (1937-1938).

In industry, Mr. Hartenstein's present position is General Supervisor of Commercial and Farm Sales, for Ohio Edison Company, Akron, with whom he has been affiliated since 1922. He is in charge of the commercial programs of the company's ten divisions, and in addition supervises the company's farm sales activities. A real native son, he works, lives in, and serves in the civic organizations of his native city, having been born in Akron in 1900, and educated in its schools (Central H. S., University of Akron, and later Ohio State University). With his wife, Frances, he has raised his family in Akron — two sons, now grown and with families of their own.

Mr. Hartenstein's background includes service in both World Wars — as a "doughboy" in 1918, and in 1942-1943 as Chief of Technical Section, 5th Service Command, Office of Civilian Defense.

The City of Akron, Ohio, has as good a reason to know Bob Hartenstein as does the lighting industry. He has served as President, Chairman and/or Director of at least sixteen civic organizations and as member of many others, including the Akron Chapter of the Red Cross, Kiwanis, YMCA management, Community Chest, National Sales Executives Club, and others. He is likewise a leader in his church affiliations and has served as Chairman, Layman's Committee, Akron Council of Churches. Nationwide, he is known for his association with Shriners, currently holding office as Potentate of Tadmor Temple.

Industry associations have also had the benefit of Bob Hartenstein's time and talent. With the Edison Electric Institute he has been a member of the National General Commercial Committee, and Chairman of the E.E.I. Wiring Committee, each of these for four-year terms. Also for four years, he served on the Executive Committee of the National Adequate Wiring Bureau.

I.E.S. members across the nation and in Canada, may look to vigorous administration of their Society, and conscientious interest in their aims, under Robert F. Hartenstein, during 1955-1956.

"Stand-Out" Lighting Characterizes

ON MORGANTOWN Street in the small town of Uniontown, Pa., a single store stands out from all its neighbors. Details of its remodeling contribute to its distinction, but, by day or at night, the lighting design planned for it is a magnet for shoppers' attention. The lighting plan was developed by Josef Tama of West Penn Power Company, Uniontown, and won for him first prize in Pittsburgh Section's contest for "My Most Interesting Lighting Job." Actually, the job is an application of lighting for merchandising basically similar to many another. For a conscientious lighting consultant, however, the opportunity of applying good lighting principles and imaginative use of equipment for the solution of a problem, adds an "interesting" aspect to any job.

Martin's is a typical small town store, housing a combination bakery, delicatessen and lunch room. Remodeling of the old store was rather informally done — there were no plans, as such. The owners could visualize how they wanted it to look, a general contractor was told to tear out a few partitions and install a glass front, and the owners did their own sub-contracting for all other works. Construction plans changed daily. Every time a piece of plaster was removed, a new problem exposed itself.

When ceiling lines were established, a floor plan to show locations of various departments was made. For the lighting design, a luminous ceiling was specified for the front area, for attraction and appeal. Spots were recommended over the baked goods counter to accentuate the buttered crispness of the rolls, and troffers in the food serving area for general lighting.

In this particular area, 25 feet wide by 45 feet long, the use of a luminous ceiling created a "show window" effect with the all-glass front, and at the same time solved a difficult problem of unevenness in the ceiling height which varied a foot between the front of the room and the back. This show window effect is further enhanced by the installation of three R-40 recessed swivel spots just inside the door entrance, two of which are trained on the daily featured wedding cake display. The owners attribute a good share of the increased wedding cake sales to this lighting. The third spot is di-

Martin's Delicatessen

rected toward the merchandise displayed on top of the case. Just outside the door, 150-watt R40 recessed spots provide 100 footcandles of illumination on the sidewalk at the entrance. Signs hung in the window for identification are all lettered on glass to prevent any obstruction to the customers looking in. Potted plants add decoration through color, texture, and variety of form.

The luminous ceiling is a grid-patterned type suspended to form a 24-inch plenum, interior of which is painted white. Continuous rows of single-lamp 48-inch slimline 430-ma strip units are on 18-inch centers, installed parallel to the supporting I-beam. Deluxe cool white lamps were used. Brightnesses of overhead lighting at normal viewing angle are well below recommended limits.

In the rear of the store, four rows of two-lamp louvered troffers on six-foot centers, divided into 12-foot sections in each row, provide good directional effect. This division of the rows of troffers provides added architectural interest through dominant and subordinate negative shapes, while maintaining positive form through the fixed shapes of the troffers. In any case, however, such division was necessary because of the I-beam and the physical structure of the ceiling. Illumination from the troffer system is over 60 footcandles.

At the rear wall, right side, a niche was included to provide additional seating capacity for the food service department. A recessed incandescent soffit was used here for local light.

Swivel spots, including 150-watt R-40 floods are located over the baked goods counter to accent the delicacies displayed in the all-glass lighted case. This furnishes especial attraction to customers on their way to the self-service area in the rear of the store.

Labels on cans and bottles in the self-service department are highlighted by wall-case lighting. Some upward component from this installation also serves to illuminate the plastic letters of the department indicator.

Most interesting aspect to the lighting advisor, however, was the verdict handed down by owners and customers, that this was the best lighted store in town.

Daylight Measurements In Six New England Schools

By WILLARD ALLPHIN

MORE AND MORE primary and elementary schoolrooms are being built with provision for additional daylighting, that is more than can be provided by windows along one wall. Wide classrooms with low ceilings are common in recent construction, offering a reason for bringing daylight into the side of the room away from the window wall. In some cases, where state codes require a minimum ratio between window area and floor area, such additional daylighting is mandatory for wide, low rooms.

Several methods are being used, for example, skylights, clerestories on the inner wall, monitors,* plastic domes. Technical papers[1, 2] have described some of these systems, and other writings in the non-technical press have sometimes implied that if substantial provision is made for additional daylighting, very little electric lighting need be installed in rooms which are not to be used for evening classes. On the other hand, some have argued that nothing more than a vision strip is justified in northern climates.[3, 4]

This introduces the question of how much illumination is received by typical desks in such classrooms.[5] Previous papers have dealt with daylighting intensities outdoors[6] and with experimental data on particular systems,[7, 8, 9] but there is a need for factual data on actual schools in different latitudes.[10]

Procedure

With this need in mind, a year's study was made of six schools in Northeastern Massachusetts and Southern New Hampshire, each having a different type of daylighting. In each school, a room was selected which seemed typical of those having the same orientation. A point about midway from front to rear wall, and located laterally so as to receive the least daylight, was used for periodic footcandle readings.

Once every hour a meter was placed on this desk, usually by the child occupying the desk, electric lights were turned off, and the meter was read. Meters were new Weston No. 703, color corrected and cosine corrected, and were correct to ±5 per cent.

Description of Rooms And Measured Results

In the following descriptions, illumination measurements were made with a Weston No. 756 meter and brightness measurements with a Spectra Spotmeter. The latter eliminates human error by measuring brightnesses electronically.[11]

Footcandle distributions in the test rooms were not measured at identical locations because of the different room sizes and seating arrangements. The points were chosen so as to give a representative picture of the distributions, and are located approximately to scale on the floor plans.

Readings of footcandle distribution and brightness were taken at noon on clear days and on overcast days. The sky brightness readings were taken by aiming the meter about half way between horizon and zenith in the direction faced by the main window walls.

Interior brightness readings were made from a seated position in the center of the rear of the room, except where a monitor window could not be seen from this position. In such cases the monitor reading only, was taken from the right rear of the room, pointing the meter midway between front and rear of room.

Results

Frequent check-ups indicated that the young people did an accurate and conscientious job of reading the meters. Occasional readings were missed on days when school was in session, but these amounted to only 6 per cent of the total of more than 5,000 readings, and since they occurred at random times, their effects would tend to cancel out.

It cannot be emphasized too strongly that the data should not be used to compare one type of daylighting system with another as to relative

*According to architects, there is some overlapping of terms in regard to monitors and clerestories. For example, the additional windows in Fig. 8 are certainly clerestories and those in Fig. 4 monitors, but those in Fig. 24 could be designated in either way.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Sylvania Electric Products Inc., Salem, Mass.

merits. Some of the factors which would make such comparisons unfair are:

Exact geographic location (weather can differ in two places only a few miles apart).
Orientation.
Outdoor surround of room.
Size and shape of room.
Exact details of fenestration.
Shades or other methods of daylight control.
Adjustment of daylight controls by teacher.
Reflectances in room.

Considering the virtual impossibility of finding any two rooms which would have different methods of providing additional daylight, but would be identical in every other important particular, the author feels that a fair comparison could only be made under laboratory conditions with model rooms and an artificial sky.

On the other hand, the combined readings should be of value because they show results actually obtained in schools which are being "lived in." Here, therefore, are the totaled readings:

TABLE I. — Summary of Six Schoolrooms. Percent of Total Readings.

	Average
Over 100 Footcandles	11%
51 to 100 Footcandles	34%
31 to 50 Footcandles	24%
0 to 30 Footcandles	31%
0 to 20 Footcandles	18%
0 to 10 Footcandles	7%
0 to 5 Footcandles	2%

Discussion of Results

Note from the measurements in Figs. 3, 7, 11, 15, 19 and 23 that on dark days the variations in footcandles across the room are much less than on bright days. Therefore, the low values in Table I are representative of more desks than are the high values.

The caution given earlier about attempting to compare the merits of the various daylighting systems also applies to the descriptive measurements of illumination and brightness. Because one "bright" day differs from another "bright" day and one "dark" day differs from another "dark" day, it would be entirely unwarranted to use the descriptive measurements to compare one school with another. The measurements are merely a general guide to how the daylight distributes itself in the rooms under some particular conditions.

Also, as was mentioned earlier, the descriptive measurements were taken at noon. This was done so as to reduce the differences due to orientation. However, it follows that the hourly footcandle readings on a test desk would include many values lower than that measured at noon on a particular dark day.

Sincere thanks are due to the superintendents, principals, teachers and students who cooperated so cheerfully and efficiently in making this project possible.

Conclusions

With the acute shortage of schoolrooms and the need to hold construction costs down, there may be a temptation to put in less than enough electric lighting to provide a minimum of 30 footcandles and to feel that on a dark day children could be shifted from the poorest locations or the program could be changed. Shifting the children would not accomplish much, because on dark days most desks are underlighted by daylight. Changing the program would seem undesirable in view of the small cost of meeting the American Standard Practice, when spread over a period of years. The American Standard Practice for School Lighting calls for a *minimum* illumination of 30 footcandles on the desk. Too often, designers overlook this point and provide an illumination which may maintain an *average* of 30 footcandles, but which therefore falls substantially below 30 in the weeks just before a cleaning.

Another point which should be mentioned is that potential savings in installation cost are not great if electric lighting is curtailed. Considering costs of wire, switches, panelboards and labor, a 15-footcandle installation costs far more than half as much as a 30-footcandle installation.

There are things which can be said in favor of extra daylighting methods, apart from any economic considerations. For example, the author feels that too much consideration has been given to their effects on dark days and not enough to their effects on bright days. On the latter, there is a very cheerful feeling from the extra light in what used to be the darker side of the room. Furthermore, the higher illumination levels raise adaptation levels so that the sky brightness seen through the side windows is less glaring.

In short, both daylighting and electric lighting systems have a place in school lighting, and neither should be considered to render the other unnecessary.

It is hoped that similar investigations will be made in more schools and in different climates and latitudes. However, on the basis of this investigation, it is evident that in climates equal to and darker than central New England, electric lighting systems in schoolrooms should be designed for a minimum illumination of not less than that recommended by the American Standard Practice for School Lighting.

Figure 1. School A.

Manasseh Cutler School
Hamilton, Mass., Room No. 2

Clear glass in window wall. Northwest exposure.

Clear glass in sloping monitor. Monitor only in forward 20 feet of room.

No shades at windows.

Walls — stained wood.

Ceiling — acoustical tile.

Floor — slate colored asphalt tile.

Number of similar rooms — 12 (one-half with opposite exposure.

Reflectances — desks, 34%; floor, 19%; front wall, 24%; chalkboard, 16%; tackboards, 52%.

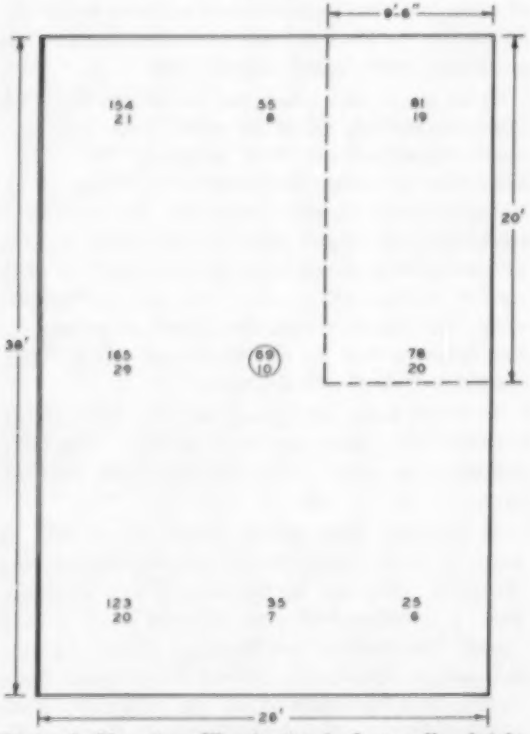


Figure 3. Plan view. Illumination in footcandles, bright day and dark day. Circle indicates test location.

Figure 2. Brightnesses in footlamberts, bright day and dark day. Brightness of monitor windows from right rear of room; bright day 1100 ft-L; dark day, 420 ft-L.

Exterior view through windows: lawn, at level of schoolroom floor, slopes gently downward for about 200 ft, then rises. Pine and shade trees start 50 ft forward of forward window and slant away from room at 45-degree angle. Pine and shade trees about 1000 ft away along skyline.

Descriptive Measurements

	Bright Day	Dark Day
Month	January	February
Time	12:30 p.m.	1:00 p.m.
Weather	Hazy sun	Raining
Sky brightness	1800 ft-L	310 ft-L
Illumination on test desk	69 ft-c	10 ft-c
Average in 12 rooms	53 ft-c	10 ft-c
Spread of data in 12 rooms	42-69 ft-c	8-12 ft-c

For other measurements, see Figs. 2 and 3.

Illumination on Test Desk, Measured Hourly over One School Year

Per Cent of Total Readings

Over 100 ft-c	5%	0 to 20 ft-c	15%
51 to 100 ft-c	38%	0 to 10 ft-c	7%
31 to 50 ft-c	32%	0 to 5 ft-c	2%
0 to 30 ft-c	25%		
	100%		

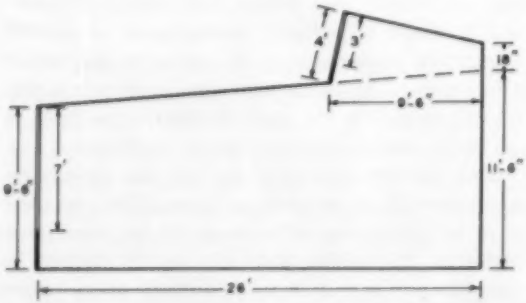


Figure 4. Sectional view. Clear glass in window wall and in sloping monitor.

Figure 5. School B.

Figure 6. Brightnesses in footlamberts, bright day and dark day.

West Parish School
Gloucester, Mass., Room No. 8

Clear glass in window wall. West exposure.

Clear glass in clerestory opposite window wall.

Translucent cloth drapes at window wall.

Walls — bluish gray plaster.

Ceiling — perforated acoustical tile.

Floor — brown asphalt tile.

Number of similar rooms — 7.

Reflectances — desks, 26%; floor, 9%; walls, 43%; chalkboard, 25%; tackboards, 23%.

Exterior view through windows: Gravel area about 6 inches below room floor. Dirt bank with some grass and brush curves from 50 feet forward of forward window to 100 feet away, normal to windows. Height of bank diminishes from about 30 feet at forward end down to ground level opposite windows, 300-foot hills on skyline about 1500 feet away.

Descriptive Measurements

	Bright Day	Dark Day
Month	January	March
Time	12:10 p.m.	11:50 a.m.
Weather	Cloudy-bright	Rain
Sky brightness	1800 ft-L	550 ft-L
Illumination on test desk	34 ft-c	6 ft-c
Average in 7 rooms	28 ft-c	5.5 ft-c
Spread of data in 7 rooms	21-34 ft-c	5-6 ft-c

For other measurements see Figs. 6 and 7.

Illumination on Test Desk, Measured Hourly over One School Year

	Per Cent of Total Readings		
Over 100 ft-c	13%	0 to 20 ft-c	13%
51 to 100 ft-c	44%	0 to 10 ft-c	5%
31 to 50 ft-c	21%	0 to 5 ft-c	1%
0 to 30 ft-c	22%		
	100%		

Figure 7. Plan view. Illumination in footcandles, bright day and dark day. Circle indicates test location.

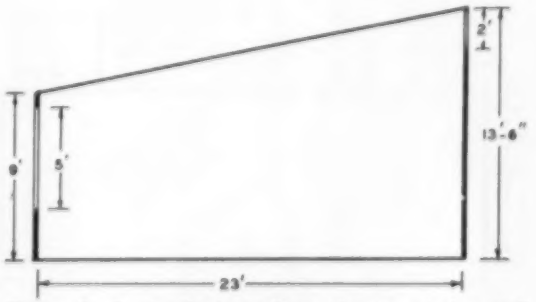


Figure 8. Sectional view. Clear glass in window wall and clerestory.

Figure 9. School C.

Figure 10. Brightness in footlamberts, bright day and dark day. Brightness of plastic domes seen from below: bright day, 1500 ft-L; dark day, 250 ft-L.

Central School, Salem, N. H.
Room No. 3

54 inches of diffusing glass over 20-inch vision strip in window wall.

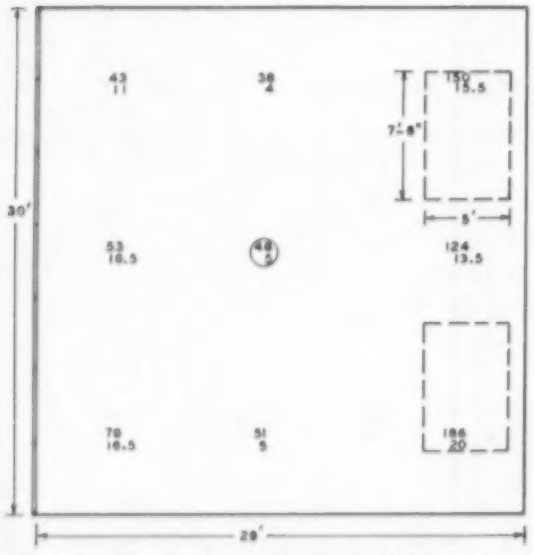


Figure 11. Illumination in footcandles, bright day and dark day. Circle indicates test location.

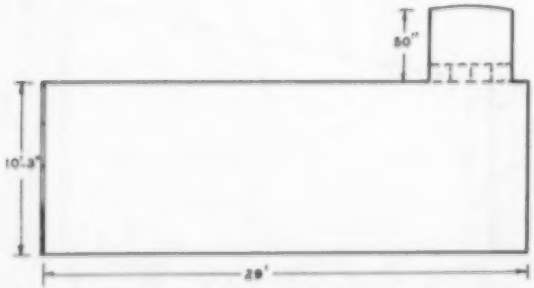


Figure 12. Sectional view. Clear plastic domes over wooden louvers.

Roller shades at windows. East exposure.

Two single layer clear plastic domes over wooden louvers.

Walls — brick, painted light buff.

Ceiling — acoustical tile.

Floor — green asphalt tile.

Number of similar rooms — 2 (one with opposite exposure).

Reflectances — desks, 39%; floor, 13 and 19%; walls, 65%; chalkboard, 21%; tackboards, 46%.

Exterior view through windows: Lawn at 6 inches above floor level. Slopes up slightly for 50 ft, then changes to asphalt pavement. One-storey red brick building starts 60 ft forward of forward window and runs normal to window wall for 70 ft. Three-storey red brick building about 250 ft away, with corner opposite forward window. Pine and shade trees on skyline about 500 ft away.

Descriptive Measurements

	Bright Day	Dark Day
Month	January	March
Time	12:10 p.m.	11:30 a.m.
Weather	Clear	Rain
Sky brightness	830 ft-L	250 ft-L
Illumination on test desk	48 ft-c	5 ft-c
Average in 2 rooms	59 ft-c	6 ft-c
Spread of data in 2 rooms	48-71 ft-c	5-7 ft-c

On bright days the roller shades are pulled down one-third of the way; on dark days they are rolled to the top. Therefore, illumination and brightness distributions were measured under the same conditions. For other measurements, see Figs. 10 and 11.

Illumination on Test Desk, Measured Hourly over One School Year

Per Cent of Total Readings

Over 100 ft-c	27%	0 to 20 ft-c	9%
51 to 100 ft-c	40%	0 to 10 ft-c	3%
31 to 50 ft-c	16%	0 to 5 ft-c	1%
0 to 30 ft-c	17%		
	100%		

Figure 13. School D.

North School, Chelmsford, Mass. Room No. 6A

Clear glass in window wall. West exposure.
Sill 12 inches above floor in forward half of wall; 33 inches above floor in rear half.
4 feet of diffusing glass in monitor.
Venetian blinds at window wall.
Front and rear walls — plaster, painted light bluish green.
Side wall — natural pine.
Dado — natural pine.
Ceiling — flat portion: perforated acoustical tile; sloping portion: plain acoustical tile.
Floor — light green asphalt tile.
Number of similar rooms — 10 (one half with opposite exposure).
Reflectances — desk, 34%; floor, 35%; upper walls, 64%; sidewalls and front dado, 36%; chalkboard, 41%; tackboards, 35%.

Exterior view through windows: Level area 6 inches above room floor. Asphalt pavement for 50 feet, then gravel. A few small pine trees forward of forward window and about 200 ft away. Pine trees on a low ridge about 1000 ft away.

Descriptive Measurements

	Bright Day	Dark Day
Month	January	March
Time	11:50 a.m.	12:10 p.m.
Weather	Clear	Cloudy
Sky brightness	980 ft-L	750 ft-L
Illumination on test desk	38 ft-c	18 ft-c
Average in 10 rooms	44 ft-c	17 ft-c
Spread of data in 10 rooms	35-71 ft-c	13-20 ft-c

For other measurements, see Figs. 14 and 15.

Illumination on Test Desk, Measured Hourly over One School Year

Per Cent of Total Readings

Over 100 ft-c	7%	0 to 20 ft-c	16%
51 to 100 ft-c	28%	0 to 10 ft-c	7%
31 to 50 ft-c	31%	0 to 5 ft-c	3%
0 to 30 ft-c	34%		
	100%		

Figure 14. Brightnesses in footlamberts, bright day and dark day. Brightnesses of windows in monitors: bright day, 480 ft-L; dark day, 390 ft-L.

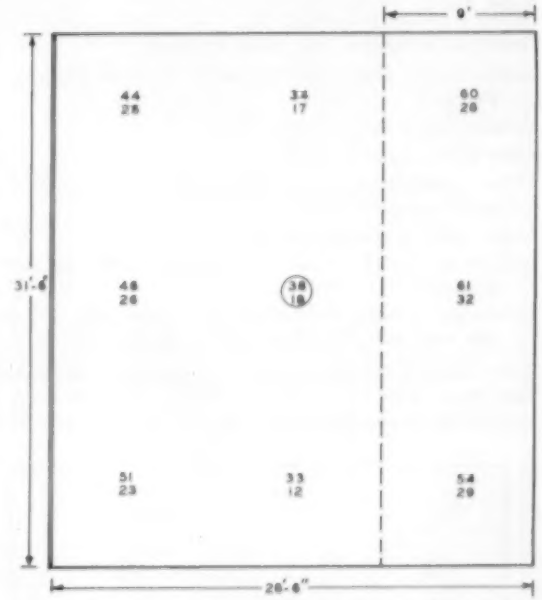


Figure 15. Plan view. Illumination in footcandles, bright day and dark day. Circle indicates test location.

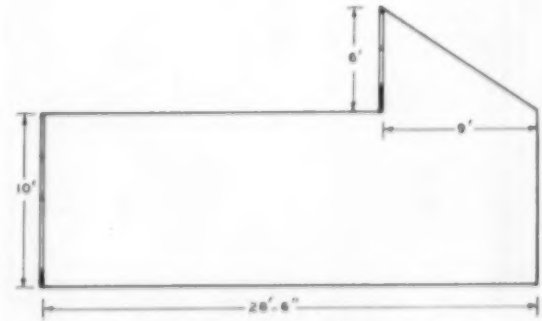


Figure 16. Sectional view. Clear glass in window wall. Diffusing glass in monitor.

Figure 17. School E.

Figure 18. Brightnesses in footlamberts, bright day and dark day.

Central School Addition, West Acton, Mass. Room No. 2

Clear glass in window wall. West exposure.

Double plastic dome skylights, lower dome of diffusing plastic.

Venetian blinds at windows.

Roller shades under skylights.

Walls — cinder block, painted light buff.

Ceiling — perforated acoustical tile.

Floor — slate colored asphalt tile.

Number of similar rooms — 8 (one-half with opposite exposure.

Reflectances — desks, 36%; floor, 24%; front wall, 73%; side wall, 48%; chalkboard, 32%; tackboards, 36%.

Exterior view through windows: Level area 6 inches above room floor. Lawn for 10 ft, then asphalt for 25 ft more, then gravel. Grassy bank 6 ft high running nearly parallel to windows 50 to 60 ft away. Wall of adjoining wing 10 ft high, starts at rear of test room and runs normal to window wall for 22 ft. First 6 ft are red brick, next 16 ft are clear glass. Fairly tall pine trees about 300 ft away, forward of forward window.

Descriptive Measurements

	Bright Day	Dark Day
Month	January	September
Time	12:15 p.m.	12:20 p.m.
Weather	Clear	Overcast
Sky brightness	1450 ft-L	650 ft-L
Illumination on test desk	69 ft-c	31 ft-c
Average in 8 rooms	80 ft-c	35 ft-c
Spread of data in 8 rooms	62-100 ft-c	28-45 ft-c

For other measurements, see Figs. 18 and 19.

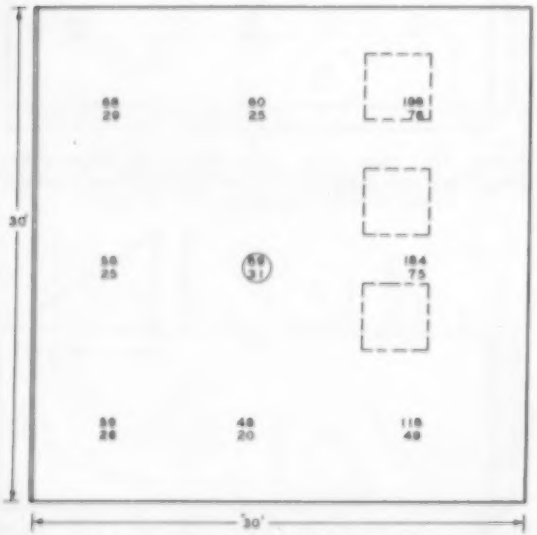


Figure 19. Plan view. Illumination in footlamberts, bright day and dark day. Circle indicates test location.

Illumination on Test Desk, Measured Hourly over One School Year

Per Cent of Total Readings

Over 100 ft-c	7%	0 to 20 ft-c	17%
51 to 100 ft-c	39%	0 to 10 ft-c	6%
31 to 50 ft-c	27%	0 to 5 ft-c	2%
0 to 30ft-c	27%		
	100%		

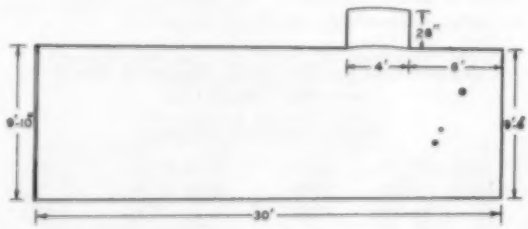


Figure 20. Sectional view. Clear glass in window wall. Double plastic domes. Lower dome diffusing.

Figure 21. School F.

Figure 22. Brightnesses in footlamberts, bright day and dark day. Brightness of glass blocks in clerestory, from right rear of room: bright day, 110 ft-L; dark day, 27 ft-L.

Fiske School, Lexington, Mass.
Room No. 8

4 feet of glass blocks above 3-foot clear glass vision strip. West exposure.

Glass blocks in clerestory facing West.

No shades at windows.

Walls — plaster, painted light peach.

Ceiling — acoustical tile.

Floor — slate colored asphalt tile.

Number of similar rooms — 8 (one-half with opposite exposure).

Reflectances: desks, 29%; floor, 10%; walls, 56%; chalkboard, 20%; tackboards, 28%.

Exterior view through windows: Level asphalt pavement 6 inches below room floor. Building 10 ft high, red brick, clear glass and glass block, about 40 ft away opposite rear window, slanting at 45 degrees into the scene and running for 130 ft. A few shade trees on a low ridge about 1500 ft away.

Descriptive Measurements

	Bright Day	Dark Day
Month	February	February
Time	12 noon	12 noon
Weather	Clear	Raining
Sky brightness	1100 ft-L	330 ft-L
Illumination on test desk	21 ft-c	3 ft-c
Average in 8 rooms	19 ft-c	3 ft-c
Spread of data in 8 rooms	15-21 ft-c	2.5-3.5 ft-c

For other measurements, see Figs. 22 and 23.

Illumination on Test Desk, Measured Hourly over One School Year

Per Cent of Total Readings

Over 100 ft-c	2%	0 to 20 ft-c	38%
51 to 100 ft-c	12%	0 to 10 ft-c	12%
31 to 50 ft-c	23%	0 to 5 ft-c	3%
0 to 30 ft-c	63%		
	100%		

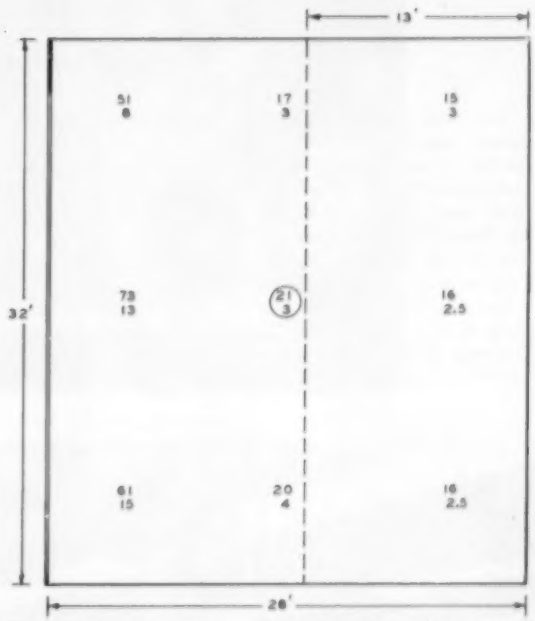


Figure 23. Plan view. Illumination in footcandles, bright day and dark day. Circle indicates test location.

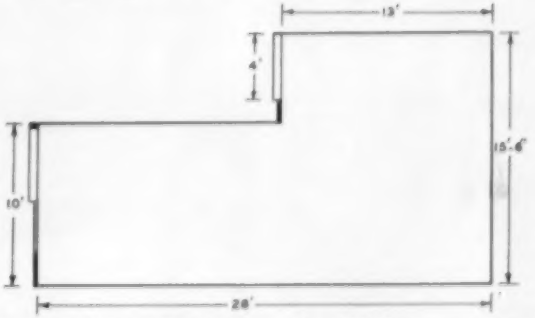


Figure 24. Sectional view. Glass blocks over vision strip in window wall. Glass blocks in clerestory.

References (Allphin — Daylight Measurements in Six New England Schools.)

1. Boyd, R. A.: "The Attainment of Quality Daylighting in School Classrooms," ILLUMINATING ENGINEERING, Vol. XLVIII, No. 1, p. 15 (January 1953).
2. Vesey, E. E., Reed, Bob H., and Evans, Ben H.: "Daylight Survey Methods," ILLUMINATING ENGINEERING, Vol. XLIX, No. 5, p. 245 (May 1954).
3. Hammel, Richard F., and Moore, Gordon: "Daylight and the Schoolroom in Northern Climates." Paper presented at IES Midwestern Regional Conference, May 1, 1953.
4. Durr, W. H.: "Too Many Windows?" Better Light Better Sight News, February 1955.
5. Green, Bernard F.: "Daylighting with Plastic Domes," ILLUMINATING ENGINEERING, Vol. XLIX, No. 4, p. 209 (April 1954).
6. Billhartz, W. H., Kingsbury, H. F., and McKinley, R. W.: "A continuous Daylight Recorder," ILLUMINATING ENGINEERING, Vol. XLIX, No. 1, p. 2 (January 1954).
7. Crouch, C. L.: "Daylighting Performance of a Pre-Tested School Design," ILLUMINATING ENGINEERING, Vol. XLVIII, No. 6, p. 343 (June 1953).
8. Kingsbury, H. F., Billhartz, W. H., and McKinley, R. W.: "Functional Top Lighting with Glass Block." ILLUMINATING ENGINEERING, Vol. XLIX, No. 4, p. 185 (April 1954).
9. Boyd, R. A., and Reid, John Lyon: "Daylighting with a New Kind of Functional Skylight." ILLUMINATING ENGINEERING, Vol. XLIX, No. 4, p. 199 (April 1954).
10. Goldstein, Stanley James: "A Matter of Light," *Progressive Architecture*, September 1952.
11. Freund, Karl: "Design Characteristics of a Photo-Electric Brightness Meter," ILLUMINATING ENGINEERING, Vol. XLVIII, No. 10, p. 524 (October 1953).

Re-Lighting for the Latest Model

The Davis Buick Company, new owners of an automobile agency, wished to make their showroom as modern and attractive as the handsome new cars they display. The transformation of a dark sales area to that shown in the "after" photo was accomplished by George Maier, Lighting Specialist, Dayton Power and Light Company, Dayton, Ohio, and won for him the second prize in the I.E.S. Miami Valley Chapter's contest for My Most Interesting Lighting Job.

The showroom is an area of 75 by 75 feet, with plate glass walls on front and north side. The original ceiling was 18 feet high, divided into sections by beams. The old lighting fixtures, using eight 20-watt fluorescent lamps, were spaced on 15- by 20-foot centers, giving an overall illumination of 5 footcandles.

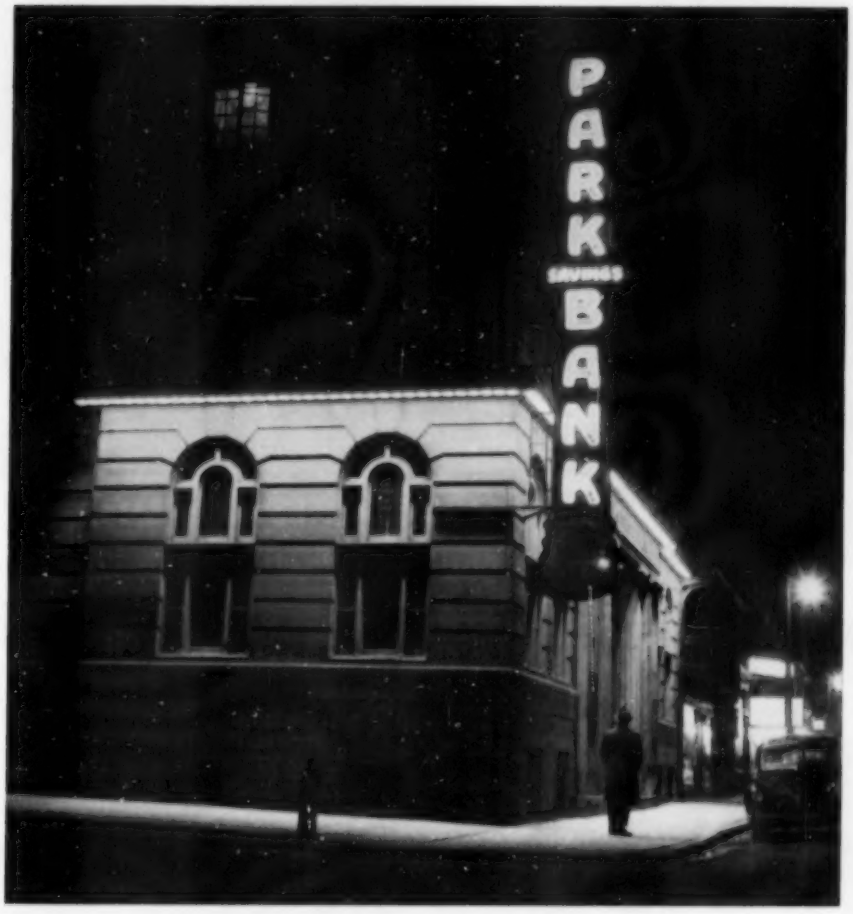
On remodeling, a new ceiling was installed, with 2- by 4-foot white Fiberglas panels suspended 12 feet above the floor, providing space above for air-conditioning ducts and wiring. Recessed in this ceiling are 91 2- by 4-foot troffers with clear ribbed glass shielding, arranged in an 8- by 12-foot design. The resulting 95 footcandles provide a comfortable sales atmosphere. For added sparkle on the shiny new cars, twelve recessed swivel units were installed.

The dark wainscoting was replaced with plywood and finished white, as were the walls.

milj

After photo, left—95 ft-c.

Before photo, below—5 ft-c.



INSTALLATION AT THE PARK SAVINGS BANK
3403 WEST LISBON AVENUE, MILWAUKEE, WISCONSIN.

Floodlighting a Building and Sidewalk

LIGHTING OBJECTIVE: To floodlight the exterior of a bank and illuminate the sidewalk in front of it.

GENERAL INFORMATION: This bank is located on a street corner which receives very little illumination from the existing street lighting and very little spill light from adjoining stores. The building (32 per cent reflectance), window trim (32 per cent reflectance) and sidewalk (40 per cent reflectance) are all gray. The bank facade is 20 feet 10 inches high (sidewalk to bottom of lighting units) and the sidewalk is 8 feet wide on the West Lisbon Avenue side near the main entrance.

INSTALLATION: The building and sidewalk are illuminated by a continuous light trough which is fastened to the underside of the exterior ledge of the building as shown in Fig. 2. This trough contains one two-lens unit, three three-lens units, twenty-two five-lens units and one six-lens unit. Each unit (A. B. Rowold & Co., Inc., catalog no. A-828) contains a spherical reflector, a 6½-inch square Holophane Controlens and a 100-watt A-21 general service lamp, all mounted on 8-inch centers. The lamp filament is positioned 2 inches above the back of the Controlens to provide a medium spread of light.

(over)

A.I.A. File No. 31

Floodlighting a Building and Sidewalk

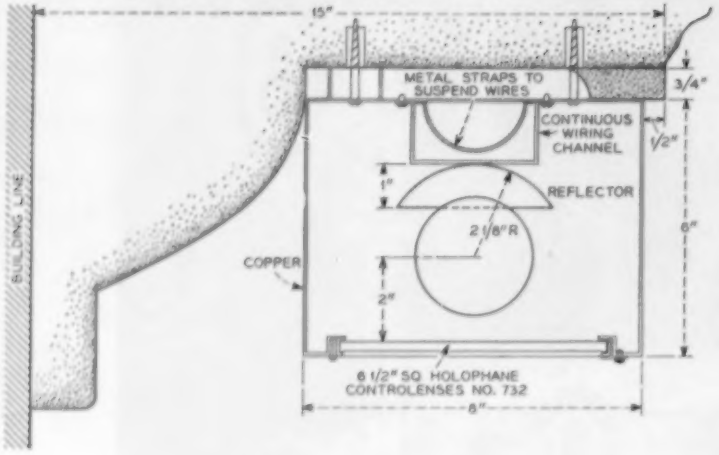


Figure 2. Cross-section exterior ledge and lighting unit.

General illumination on the West Lisbon Street side near the main entrance is as follows:

Building	
close to top	16. ft-c
6 feet above sidewalk	1.9 ft-c
bottom	1.25 ft-c
Sidewalk	
near building	10. ft-c
near curb	6. ft-c

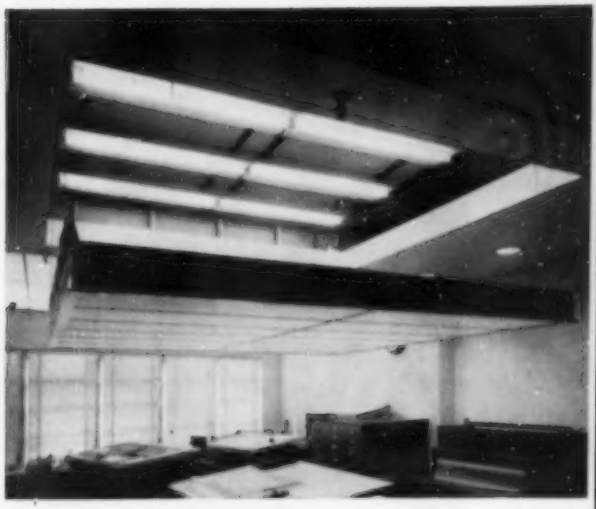
Brightnesses are as follows:

Building	
top	5. ft-L
middle	1. ft-L
bottom	0.4 ft-L
Window trim	
top	4. ft-L
Sidewalk	
near building	4. ft-L
near curb	2.4 ft-L

Lighting designed by Thomas B. Dustin, A. C. Electric Co., 2326 West Walnut Street, Milwaukee, Wis.

Lighting data submitted by Richard L. Garber, Wisconsin Electric Power Co., 231 West Michigan Street, Milwaukee, Wis., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.



Functional Lighting from a Working Model

By CHARLES K. CHAMPLIN

A section of luminous-louverall ceiling in this engineering office provides light for design and drafting work and at the same time is a working model for studying lamp and mounting-space problems.

ENGINEERING and drafting work for the design of lighting equipment is the function of this office. The lighting system employed for it has a dual purpose, however. High level illumination with environmental features for quality lighting is provided by a system which is also designed to allow study of its operating characteristics under a variety of circumstances.

The office is an 18-foot by 22-foot area with an 11-foot structural ceiling. Surface brightnesses have been carefully controlled for quality; walls are pale green (RF 60); floor light tan marbleized linoleum (RF 30); windows are southern exposure, necessitating the use of Venetian blinds, medium green (RF 30).

General lighting is provided over the drafting and reference tables by a luminous-louverall ceiling dropped 20 inches below the structural ceiling. Within the cavity (painted flat white RF 80) are 19 eight-foot one-lamp strip fixtures with 750-volt choke coil type two-lamp ballasts. Current supplied to the luminaires is from a 110-volt line through a multi-tap step-up transformer. Voltage to the two-lamp choke coils is varied in four steps from 375

AUTHOR: The Edwin F. Guth Company, St. Louis, Mo.

TABLE I.—Illumination Data of the Ceiling Area over Drafting Area.

Applied Voltage	Footcandles on Tables	Brightness at 45° Footlamberts
750	80	140
625	68	120
500	50	90
375	22	60

Accent lights provide 65 footcandles.

TABLE II.—Data of Variable Test Ceiling, Spacing of Strips 12 Inches.

Cavity Depth	425 ma		200 ma		Brightness Variation*
	Ft-c	Ft-L at 45°	Ft-c	Ft-L at 45°	
6″	90	210	36	95	30 Ft-L
8″	92	185	36	90	25 Ft-L
10″	92	180	35	90	15 Ft-L
12″	89	180	35	90	Not Noticeable
14″	85	170	33	85	"
16″	82	170	32	85	"
22″	82	150	32	50	"
30″	85	140	33	48	"

*Determining lamp spacing limitations for a set cavity depth is a main function of the installation. Tabulations shown are results of a few of the many variations possible.

volts to 750 volts by a high-voltage tap selector switch mounted flush in the wall, thereby providing four intensity levels of illumination, from 20 footcandles to 80 footcandles. Brightness varies from 60 ft-L to 140 ft-L at 45 degrees. Accent illumination for scrutiny of old drawings and for close study of designs is from 150-watt PAR38 lamps mounted in adjustable bullet design luminaires hung on rods dropped through the ceiling louvers. These have concentric louvers and are separately switched.

The ceiling section measures 8 feet square and can be raised and lowered by a winch coupled to an electric ration motor. In the cavity above the ceiling are tracks to which are attached 4-foot Rapid Start strip fixtures, wired with three-wire connector cords and dimmer ballasts.

Connected to the two duct strips fitted with three-wire midget receptacles, is a Thyratron tube dimming apparatus, by which 425 ma, 200 ma and 120 ma lamp operation may be simulated. Thuswise installed, the three components of the intensity and quality of illumination from a louverall ceiling namely, lamp spacing, cavity depth and lamp brightness can be each one varied with minimum effort to obtain values for any set problem. The tabulations shown are the results of a few of the many variations possible.

Lighting for Seeing in the Dark

When two Marquette University professors, from the School of Medicine, saw a display demonstration using ultraviolet light and fluorescent chalk, they saw also a solution to one of their most vexing problems — illustrating, on the chalkboard, the slides and projection material they showed in the darkened lecture-room.

Putting the idea into practice involved the modification of a standard chalkboard lighting unit with visible-light-absorbing cobalt glass and 48-inch 360 BL lamps.

The design, trial installations and ultimately successful result in the Histology Laboratory, Department of Anatomy, was a "most interesting lighting job" for E. H. Schaefer, Wisconsin Electric Power Co., and won second prize in the Milwaukee Section's contest.

INSTALLATION AT NEW YORK LIFE INSURANCE COMPANY
51 MADISON AVENUE, NEW YORK, N. Y.

Lighting a Board Room

LIGHTING OBJECTIVE: To provide three-level illumination under remote control for completely flexible lighting in a board of directors room.

GENERAL INFORMATION: The board room, originally rectangular in shape, was remodeled into the elliptical room shown above. It measures 47 feet (major axis) by 25 feet (minor axis); ceiling height is 14 feet 4 inches (at the highest point). Colors and reflectances are as follows:

ceiling	ivory	79.3% RF
wall		
above cove	ivory	79.3% RF
below cove	nile green	45% RF
wainscot	walnut	17% RF
floor	medium blue green	21% RF
table top	green felt with walnut perimeter	5% RF
chairs	leather to match wainscot	17% RF

INSTALLATION: Fig. 2 shows the location of all lighting equipment. The recessed baffled downlights, mounted in an elliptical pattern to follow the outer edge of the board table, are located so that their light will fall both on the table top and on the laps of the board members. These units have 4⅛-inch diameter apertures, are 14¾ inches deep overall and use 75-watt R-30 spot lamps.

The rectangular lens units recessed in the ceiling near the cove, following the curve at each end of the room, are positioned to light the walls. They have 3½ by 6-inch rectangular apertures

(over)

A.I.A. File No. 31-J

and are mounted 7¼ inches on centers. Each unit is equipped with a polished Alzak aluminum reflector, a rectangular Fresnel lens and a 40-watt A-19 inside frosted general service lamp. Louvered units with rectanbular Fresnel lenses and 14 40-watt A-19 lamps are recessed in the soffit over each doorway lighting the doors and nearby vertical surfaces. These are equipped with 8-foot polished Alzak aluminum reflectors.

A light cove runs around the entire perimeter of the room. Individual Alzak aluminum reflectors with clear stippled lenses and 25-watt A-19 general service lamps are mounted on wiring channels (four reflectors per channel) and strap iron brackets. The reflectors are spaced 8 inches on center around the entire light cove.

All of the lighting equipment is controlled by remote control dimmers operated from either of the two doors to the room. There is a separate dimmer control for each set of lights: one for the downlights over the table, one for the wall lights and one for the cove lights. The entire system can be turned on and off through thedimmers without resorting to switches.

All of the lighting equipment was specially designed by Thomas Smith Kelly and manufactured as follows: remote control dimmers provided by the Superior Electric Company, Bristol, Conn.; all lenses and cove lighting equipment provided by Kliegl Brothers Universal Electrical Stage Lighting Co. Inc., New York, N. Y.; and all other equipment provided by Modern Metal Manufacturing Company, New York, N. Y.

Average illumination in the working area on the table top is 22.5 footcandles. Average illumination in the walking area (between table and wall), 32 inches above the floor, is 5 footcandles. Brightnesses under full illumination are as follows:

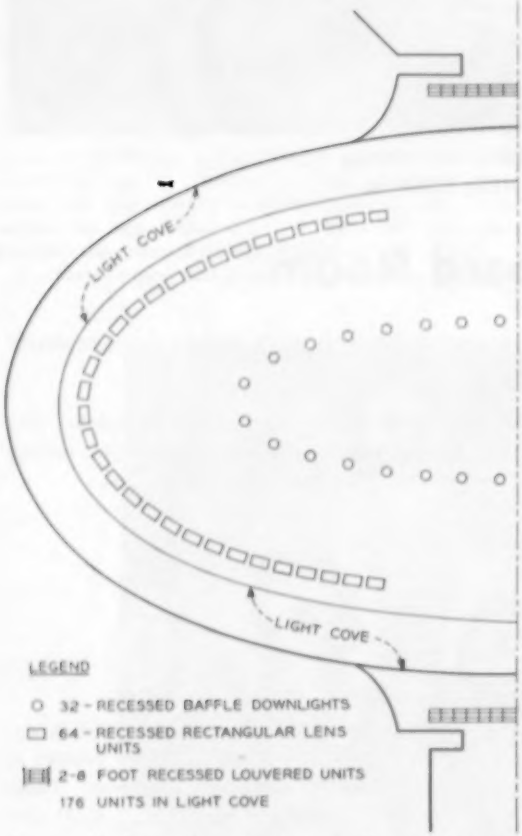


Figure 2. Plan view showing location of lighting equipment.

ceiling	
near cove	9.35 ft-L
at center	3 ft-L
wall	
below cove	1.42 ft-L
at wainscot	.28 ft-L
floor (average)	.80 ft-L
cove	
bottom	.825 ft-L
front face	2.4 ft-L
brightest point above	9.35 ft-L
baffle downlights	
ceiling plate edge (at 25°)	35 ft-L
fresnel lens downlights (at 25°)	43 ft-L
table top	
center (green felt)	.62 ft-L
edge (green felt)	1.1 ft-L
edge (walnut wood)	2.9 ft-L

Lighting designed by Thomas Smith Kelly, lighting consultant; architect: Arthur C. Holden, Holden, McLaughlin & Associates.

Lighting data submitted by Thomas Smith Kelly, Thomas Smith Kelly Lighting, 115 East 60th Street, New York 22, N. Y. as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Series XX 10-55

Characteristics of Power Supplies For Emergency Fluorescent Lighting

By ALBERT B. TOLLEFSEN
H. E. WEST

For emergency, plant security, research, and other purposes, it is becoming increasingly necessary to arrange for battery powered fluorescent lighting systems. The need may be simply for emergency lighting; or it may be for portable "black light" equipment used for personnel identification systems. Ultraviolet fluorescent lamp systems are also used in germicidal applications where food is prepared or stored. Portable, battery-operated-systems may be required where foodstuffs and other organic supplies are transported by truck. The research use of "black light" systems, whether in the laboratory or in the field, as in the case of geodetic work, has been well established. Although these lights can be operated directly from high voltage B batteries, the lumen output will not be as high as the output obtained when the lamps are operated directly from an a-c source. Efficiency and lamp life also suffer from direct battery operation.

A vibrator power supply, when used to provide high voltage from a battery, provides an a-c output which permits greater circuit efficiency and longer lamp life, thus allowing the designer to use a low voltage battery of greater capacity. The battery may also be of the rechargeable type which constitutes another advantage of using a vibrator supply.

Vibrator supplies for various fluorescent type lamp applications have been designed for general illumination purposes, germicidal lamps, "black light" for instrument panels and research use. In the article, characteristics of vibrator power supply circuits are described.

Vibrator Power Supply Design

The variation of characteristics of each type of lamp must be taken into consideration when a vibrator power supply is designed. To obtain good operation, the power supply and transformer design must be tailored to fit each application. Therefore, it is necessary that the following lamp characteristics and other factors be established before attempting the power supply design:

(1) Operating voltage of the lamp.
(2) Voltage drop across the lamp.
(3) Operating current of the lamp.
(4) Filament current required by the lamp during starting.
(5) Regulation required of the lamp current while operating.
(6) Power source to be utilized. The power source may range from flashlight batteries to large capacity lead-acid cells and may vary over a wide range of voltage but each presents its problem to the designer and so the source must be established in advance of the power supply design.

Table I shows the characteristics for a variety of lamps which have been successfully operated from a vibrator power supply.

Vibrator power supplies can be made for any lamp size up to 40 watts rating per vibrator. Where the loading is 20 watts or less, and it is desirable to do so, several lamps may be operated from the same power supply. Where the loading exceeds 20 watts it is usually better to use only one lamp per vibrator as longer overall vibrator and lamp life will result. Also in the case of a component failure only one lamp is affected and illumination will be provided by the remaining lamps.

The power supply efficiency will vary according to the application. However, efficiencies ranging

TABLE I — Lamp Characteristics.

Watts	Rated Voltage	Lamp Drop	Starting Current	Running Current
*4	110-125 Volts	37 Volts	.190 Amps.	.130 Amps.
*6	"	46	.240	.160
*8	"	59	.270	.175
15	"	56	.650	.305
†15	450 V. Start	170	—	.100
20	110-125 Volts	62	.650	.355
30	"	103	.650	.345
40	"	108	.750	.410

*These sizes are most commonly used for "Black-Light" portable use. These lamps have the same operating characteristics as the white or daylight lamps but the type of glass and coloring is designed to pass ultraviolet light.
†T-42, slimline, 42" hot cathode type, no filament.

Authors: Chief Engineer and Application Engineer, respectively, Vibrator Division, P. R. Mallory & Co., Inc., Indianapolis, Ind.

from 45 per cent for 4- and 6-watt lamps to 70 per cent for 15- and 30-watt lamps are common. Starting current must be limited through the lamp filaments to prevent burn-out. The starting current is usually 1½ to 2 times the running current. After the lamp is started the current again must be limited to the proper running value or the mercury vapor gas column within the lamp would conduct sufficient current to ruin the lamp. Thus, while there are several different circuits which might be used, all will have this common characteristic of providing regulation of the lamp current while starting and running.

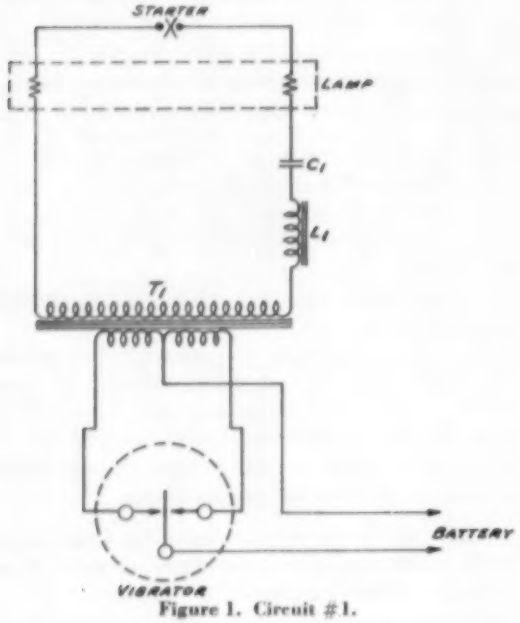


Figure 1. Circuit #1.

Circuits

Circuit #1 shows a typical vibrator power supply very similar to that used for 110 volt a-c lamp operation. The vibrator and transformer provide 110 volts a-c on the secondary side. L_1 is an iron core reactor similar to that used for 110-volt, 60-cycle use except that it is designed to operate at the vibrator frequency. The inductance provides the high voltage transient for starting the lamp. The transformer follows conventional vibrator transformer design practices using E-I laminations. Condenser C_1* has a two-fold function; first it takes the place of the conventional "buffer" condenser normally used in vibrator circuits to provide proper timing for optimum vibrator operation, and second, when properly proportional with the circuit inductances, it provides for essentially a zero-current on the break of the vibrator contacts, thus insuring long life.

Circuit #2 gives the same type of operation as circuit #1 except that the vibrator power transformer has been combined with the reactor to conserve size. This is accomplished by using an L

*P. R. Mallory & Co., Inc., U. S. Patent No. 2,194,288.

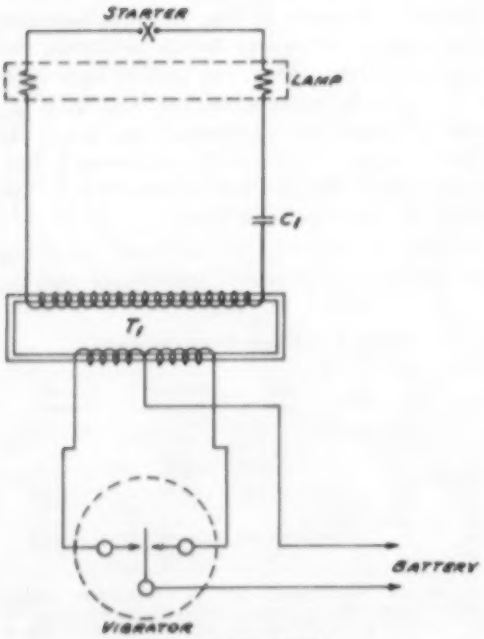


Figure 2. Circuit #2.

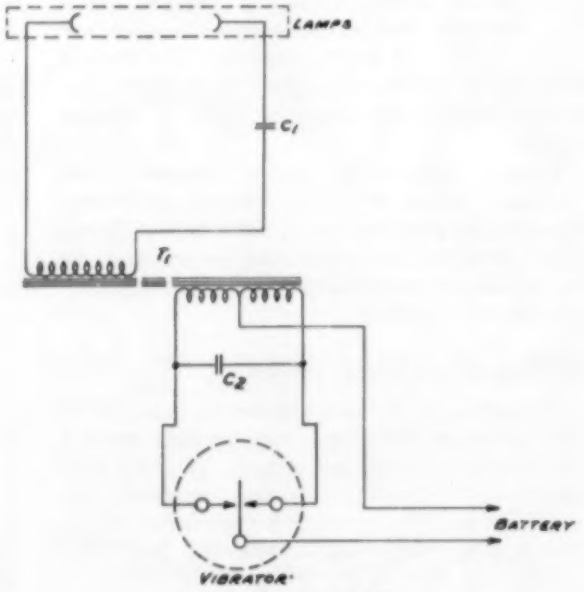


Figure 3. Circuit #3.

type lamination and winding the primary and secondary coils separately so that they may be placed on separate legs. This effectively isolates the coils by the limiting reactance of the long flux-path and closely controls both the starting and running current of the lamp.

Circuit #3 is quite different from circuits #1 and #2, although the operation is very similar. This circuit is designed for the "slim-line" or self-starting lamp which has no heater filament. However, a hot cathode is provided at each end of the lamp to assist in starting and prevents blackening of the lamp during the operating life. In this circuit also the vibrator power transformer serves as both the transformer and the reactor. It is designed on a double E lamination and is butt stacked. The coils are wound separately and assembled on the center leg with a definite space between them to provide the necessary limiting reactance for proper lamp operation. The circuit also shows a primary "buffer" condenser C_2 which is necessary on all circuits operating from a 12-volt or higher battery to assure good starting conditions for the vibrator.

All of these circuits are sufficiently flexible so that each design can be used for nearly any lamp size up to the wattage capacity of the vibrator. Each will be found to have its advantages and disadvantages so the designer can choose to fit his needs.

Brightness and Illumination By Interreflections in Enclosures

Discussion of paper by Robert S. Wiseman

(Published May 1955 issue ILLUMINATING ENGINEERING)

DOMINA EBERLE SPENCER*: Dr. Wiseman, in his Ph.D. thesis has repeated, with certain modifications, the experimental work done in Churchill's S.M. thesis.[1] The first and most important question is how the experimental results of Wiseman and Churchill compare. The comparison is made more difficult by the fact that both room shapes and reflectances are different in the two researches.

Table I and Fig. 1 show a summary of the experimental data of Churchill and corresponding calculated values obtained from the basic interflection equations for the reflectances and shapes of rooms used in this investigation. Measurements were made in six rooms with values of k_r running from 0.167 to 1.00. The luminous ceiling is constructed of tracing paper and has an equivalent reflectance of $\rho_2 = 0.608$ while walls are white, $\rho_1 = 0.885$, and floor is gray, $\rho_3 = 0.236$. Because of unforeseen experimental difficulties in maintaining calibration of measuring instruments, Churchill gives only the ratio of the helios of the walls to the ceiling, at the center of the wall and $h/4$ from the top of the walls and the ratio of the helios of the floor to the average incident pharosage on the principal surface. Data for these three ratios are in good agreement with the calculated values, the error ranging from 0.35 per cent to 11.4 per cent. For only one point does the error exceed 10 per cent.

Similar data abstracted from Wiseman's thesis are given in Table II and Fig. 2, where they are compared with values calculated from the interflection method by Wiseman. Unfortunately, Wiseman uses only a limited range of k_r (0.520 to 0.993) and entirely omits those cases of small k_r which are most important in practice. Wiseman's ceiling and floor reflectances are slightly higher than Churchill's; his wall reflectances lower. Nevertheless, the values are sufficiently similar to Churchill's so that comparable errors might be expected. Instead, Wiseman's errors are much greater, varying from 0.3 per cent to 33.8 per cent. For similar shapes of rooms, the per cent errors found by Wiseman are *3 to 20 times* those obtained by Churchill. This discrepancy is indicative of the differences between the photometric measurements of two careful workers at the present time!

In a few cases Wiseman has found discrepancies between his calculated and experimental values of as much as 48 per cent. The discrepancies between the two investigators would indicate that if the experiments were repeated by still another investigator a 48 per cent error might be replaced by a 1.6 per cent error or perhaps by an error of over 100 per cent. The conclusion of the comparison of the Churchill and Wiseman tests is a rather discouraging comment on contemporary photometry. The discrepancies between experimental investigators are greater than the errors we are trying to measure!

In addition to the experimental work, Wiseman's thesis contains a long introduction in which the algebra of the development of our interflection equations[2] is repeated. There is nothing original presented here. The outstanding peculiarity is repeated reference to "theoretical equations developed in this thesis" and the "use of equations derived in this thesis." As a matter of fact, no *new* equations are derived in the entire thesis. Our basic interflection equa-

*University of Connecticut, Storrs, Conn.

TABLE I. — Comparison of Churchill's Experimental Data[1] with Calculations Made by the Interflection Method.[2]

$\rho_1 = 0.855$ $\rho_2 = 0.608$ $\rho_3 = 0.236$

k_r	H_2/H_{1T} calculated	observed	% error
0.167	1.90	2.10	10.5%
0.333	1.93	2.15	11.4%
0.500	1.96	2.13	8.7%
0.667	1.99	2.11	6.0%
0.833	2.03	2.11	3.9%
1.000	2.08	2.09	0.5%

k_r	H_2/H_{1N} calculated	observed	% error
0.167	2.00	2.15	7.5%
0.333	2.11	2.22	5.2%
0.500	2.22	2.32	4.5%
0.667	2.34	2.40	2.6%
0.833	2.47	2.51	1.6%
1.000	2.61	2.62	0.4%

k_r	H_2/D_{AV} calculated	observed	% error
0.167	0.228	0.236	0.35%
0.333	0.218	0.226	0.37%
0.500	0.211	0.219	0.38%
0.667	0.205	0.213	0.39%
0.833	0.195	0.207	6.1%
1.00	0.186	0.198	6.5%

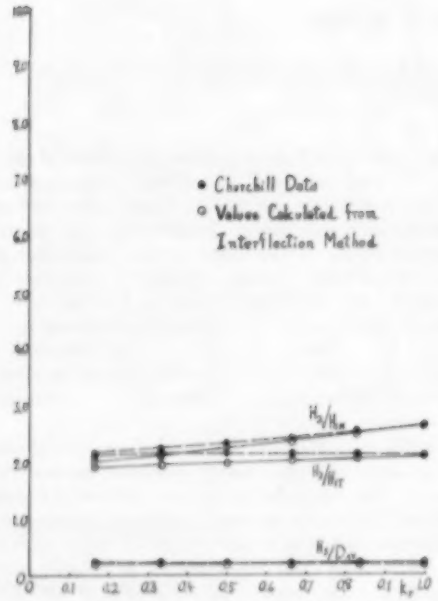


Figure 1. (above) Graphs showing experimental data of Churchill and corresponding curves calculated from the interflection method. $\rho_1 = 0.855$, $\rho_2 = 0.608$, $\rho_3 = 0.236$.

Figure 2. (right) Graph showing experimental data of Wiseman and corresponding curves calculated by Wiseman from the interflection method.

TABLE II. — Comparison of Wiseman's Experimental Data with Calculations Made by the Interflection Method.*

$\rho_1 = 0.709$, 0.692, 0.636 $\rho_2 = 0.685$ $\rho_3 = 0.269$

k_r	H_2/H_{1T} calculated	observed	% error
0.520	2.92	3.68	22.6%
0.743	2.75	3.68	33.8%
0.993	2.86	3.67	28.7%

k_r	H_2/H_{1N} calculated	observed	% error
0.520	3.41	4.16	22.0%
0.743	3.36	4.18	24.4%
0.993	3.76	4.32	14.9%

k_r	H_2/D_{AV} calculated	observed	% error
0.520	0.230	0.236	0.3%
0.743	0.250	0.258	0.3%
0.993	0.205	0.218	6.3%

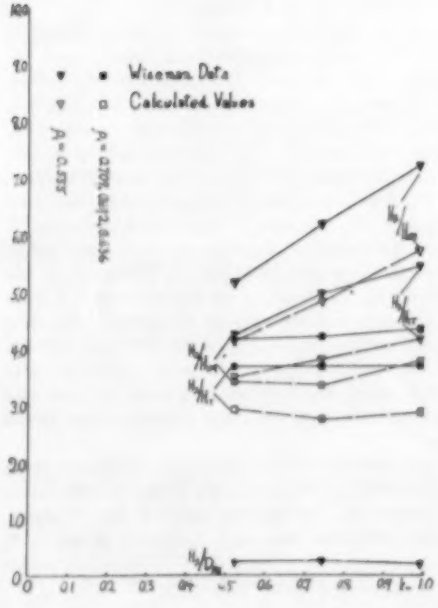
$\rho_1 = 0.555$ $\rho_2 = 0.685$ $\rho_3 = 0.269$

k_r	H_2/H_{1T} calculated	observed	% error
0.520	3.50	4.25	21.4%
0.743	3.80	4.95	30.2%
0.993	4.14	5.44	31.4%

k_r	H_2/H_{1N} calculated	observed	% error
0.520	4.12	5.15	25.0%
0.743	4.82	6.17	28.0%
0.993	5.73	7.18	25.4%

k_r	H_2/D_{AV} calculated	observed	% error
0.520	0.227	0.241	6.2%
0.743	0.211	0.227	7.6%
0.993	0.1945	0.209	7.2%

*Calculations made by Wiseman.



tions[2] are merely copies while algebraic details too lengthy to include in publication are filled in.

If Dr. Wiseman would look in Appendix D of *Lighting Design* he would find that the typographical error in the equation for H_3 has long since been corrected. The transposition of the reflectance ρ_3 in the equation for D was pointed out by Phelps Meaker some years ago. Both seem to be typographical errors not used in the calculation of the interflection tables.

Dr. Wisemans definition of luminosity is either confused or confusing. He might well study the concept of helios. The chief unknown in the interflection problem is the helios of the surround. This concept has meaning in a perfectly general sense. The notion of "luminosity" as defined by Wiseman is numerically equal to that of helios for a *perfectly diffusing surface viewed in a transparent medium* but is of no interest whatsoever if the surface is not perfectly diffusing. The problem is to determine the appearance of the surround as viewed by an observer in the room—not to find the total number of lumens emitted from a given area.

Most of us feel that the reflectance of a surface is one of our best-defined photometric concepts. Wiseman, on the other hand, says that "there is little agreement as to what is meant by" reflectance and has the peculiar notion that the reflectance of a uniform painted surface depends on its position in the room. If he would take the trouble to calculate his reflectances from the $\rho(\lambda)$ curve obtained on the G.E. spectrophotometer and a knowledge of the $J(\lambda)$ curve for the incandescent lamp he is using he would obtain a *unique* specification of the reflectance of the opaque surfaces. For the determination of a *unique* equivalent reflectance of luminous ceiling or luminous walls, the equation presented[3] five years ago in the *Journal of the Franklin Institute* should be used. If Wiseman calculates the reflectance and transmittance of his sandblasted Plexiglas and substitutes into these equations, he can expect to find new calculated curves for H_2/H_1 which will not exhibit the peculiar dips shown in Wiseman's calculated curves in Fig. 1.

As a final question, why does Dr. Wiseman consider a Luckiesh-Taylor helios meter sufficiently reliable to use as a basis for the calibration of his L-meter? Does this L-meter really read the total flux emitted *from* his surfaces per unit area?

1. Russell D. Churchill, "Investigation of the Application of the Interflection Theory," S. M. Thesis, Case Institute of Technology, 1950.
2. Moon and Spencer, "Light Distributions in Rooms," *J. Franklin Inst.*, 242, 1946, p. 111; "Lighting Design by the Interflection Method," *J. Franklin Inst.*, 242, 1946, p. 465; *Lighting Design* Addison-Wesley Press, Cambridge, Mass., 1948.
3. Moon and Spencer, "Interflections in Coupled Enclosures," *J. Franklin Inst.*, 250, 1950, p. 151-166.

ROBERT S. WISEMAN:* I had previously compared my results with those of Mr. Churchill and came to the same obvious conclusions that our results did not agree. I did not find enough information in Mr. Churchill's thesis or 1951 conference paper to determine why we differed, and I had hoped, since Mr. Churchill had sought Dr. Spencer's comments during the progress of his work and she had a copy of my thesis,** that Dr. Spencer might be able to explain the differences. She evidently cannot explain them either. From an analysis of the possible sources of experimental errors and their probable magnitude, I did not find any which if they did exist and were corrected would consistently decrease the variation between the experimental and theoretical data. It was concluded that the differences between the theoretical and experimental results in my work must be because of the assumptions and approximations made in the theoretical derivation.

I wish to thank Dr. Spencer for pointing out those places in my thesis and paper which were not clear to her. Perhaps the following will clarify some of the misconceptions evident in her comments.

For the record, since I do not find Mr. Churchill's paper published, Mr. Churchill used rooms with k_r-values of 0.333 and 0.167 beyond the range which I used. Mr. Churchill limited his studies to only ceiling lighting with one wall and one floor reflection factor. The data presented in my thesis and paper include ceiling and floor lighting with two different wall reflection factors and, in addition, data for wall lighting. It was anticipated that my test room would be used in the future to obtain data for smaller k_r values. Also, contemplated for the future was a study of the effects of furniture and other variations found in an actual room. Mr. Churchill obtained wall brightness data (ceiling lighting) only at ¼ and ½ the distance from ceiling to floor whereas the data obtained for my thesis include wall data at ⅛, ¼, ⅜, ½, ⅝, ¾ and ⅞ the distance from ceiling to floor and at twelve positions along the wall. He used tracing paper as a diffusing medium whereas previous experimentation to determine what material to use in my experimental room showed that the sand-blasted Plexiglas was the most satisfactory approximation for the "perfectly diffusing" medium. Although Dr. Spencer criticizes my use of a Luckiesh-Taylor Brightness meter, she neglected to state that *all* Mr. Churchill's data were taken with the Luckiesh-Taylor meter. The meter which I used was calibrated by taking from ten to fifty readings for each calibration point throughout the range and calibrated brightnesses were obtained by using a long photometric bench, calibrated standard lamps, and a freshly smoked magnesium oxide disk. Even when using this meter for only the calibration purposes, external batteries and ammeter were used to obtain constant conditions; the lamp was used only a short period of time so that lamp flux would not depreciate; probable deviations were calculated to assure sufficient readings had been obtained for accuracy; and when the L-Meter was calibrated readings were taken simultaneously with both meters.

I am surprised that Dr. Spencer should think that there would be anyone who did not know that she and Professor Moon "derived" the equations for the interflectance factor method first. Certainly anyone would be foolish to check final equations experimentally until he had first checked the derivation of the equations. Since the original works by Professor Moon and the final works by both Professor Moon and Dr. Spencer were published in a series of papers in the *Journal of the Optical Society*[1,2,3,4] and *Journal of the Franklin Institute*[5,6] from 1940 to 1946 and since they changed both nomenclature and symbols in the middle of the series, it was desirable to present a consolidation of the development with consistent symbols and nomenclature and with an explanation for the intermediate steps.

The use or definition of the term "luminosity" (changed to "luminous emittance" for publication in IE) is neither confused nor confusing. If Dr. Spencer will refer to texts by Prof. Moon[7] and Prof. Boast,[8] she will find this term and

*Author.
**Some copies of Dr. Wiseman's M.S. and Ph.D. theses are available from the author.

definition used. If she will reread the original interflectance articles by Professor Moon,[1,2,3,4] she will find that the term "luminosity" and the same definition were used as the foundation of the development in which she is the co-author in 1946.[5,6] And if she will refer to the sample calculation given in the Q & Q Report #3,[9] she will find that the initial brightness (luminosity, luminous emittance) was calculated as indicated by this definition.

Dr. Spencer neglected to mention in her emphasis of "a perfectly diffusing surface viewed in a transparent medium" that these two conditions were postulated in the development of the interflectance equations and, if the surfaces are not perfectly diffusing and the medium in the enclosure not transparent, none of the equations or tables apply nor will the use of her term "helios" solve the problem. It is agreed that the problem is to determine the appearance of the surround (pp. 128-129 in the complete thesis), and if the surfaces are not perfectly diffusing, this problem has not yet been solved.

As stated in the paper and thesis, the reflection factor was defined as the ratio of the total reflected luminous flux to the total incident luminous flux. These quantities were determined by measuring a portion of the luminous flux reflected from the enclosure surface and from a standard surface which had similar reflection characteristics and which was held at the same location. These data were obtained with the surfaces in the enclosure and at each time the illumination and luminous emittance were measured so the effects of the enclosure and any other changes would be included. This method of obtaining reflection factors is more accurate than making calculations using other measured data and equations which contain approximations.

Since the variations of measured reflection factors were very small (p. 233 original paper), any discussion of the "peculiar notions" is academic and would not influence the results of the studies. It was observed that the measured reflection factors did vary slightly and an analysis of the pattern of variation resulted in the conclusion that the corners of the enclosure form light traps. Although the surface would have the same "painted" reflection factor in the corner, the relative amount of light returned to the enclosure by the corner would be less than the amount of light returned to the enclosure from an area the same size located in the center of the surface. Thus, it was stated that the corners had a lower "effective" reflection factor.

Unfortunately I did not receive a copy of the Fig. 1 referred to, but in none of the curves, that I have plotted for the data, have I obtained any peculiar dips. Assuming that Dr. Spencer has found some curve with a peculiar dip, the changing of a value of reflection factor for any one set of data will merely raise or lower the curve but would not smooth any dips.

Certainly, one should not use the Luckiesh-Taylor Brightness Meter as a standard instrument unless it has been carefully calibrated by the individual who is going to use it. Such a calibration was made. Obviously the L-meter did not read the total-flux emitted from the surface per unit area, but it was calibrated so the portion of the total flux reflected by this approximately perfectly diffusing surface in the direction of the meter indicates the total flux emitted. By using a lens to confine the measurements to a fixed area, one obtains more control than using an open tube as shown in Dr. Spencer's book, Fig. 1.10,[10] for the diagram of a "helios" meter.

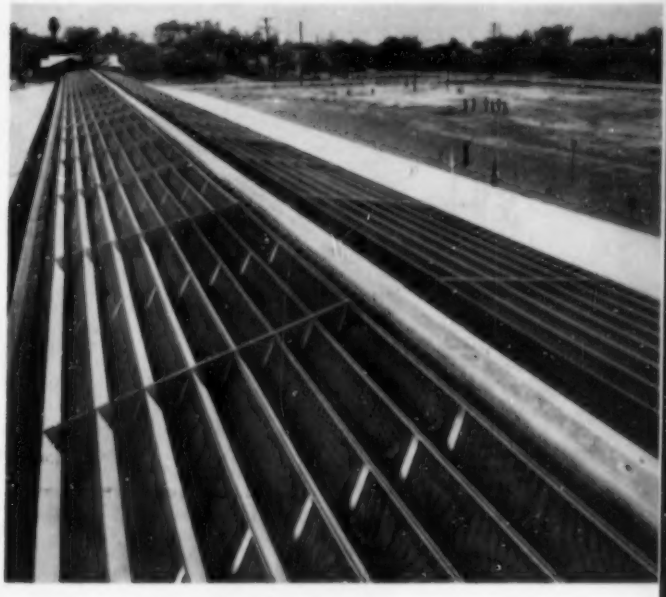
The purpose of this research was not to obtain experimental results that would verify the theoretical equations exactly but to establish test conditions as nearly like the ones in the basic premises and to determine the variation between experimental and theoretical results. Then, the problem was to determine how the theoretical equations could be modified to obtain results comparable to the experimental ones. It was concluded that for most applications no modifications were necessary, but, for more exacting cases, the "correction factors" could be used.

References

1. Moon, Parry: "On Interreflections," *J. Optical Society of America*, v. 30, pp. 195-205 (May 1940).
2. Moon, Parry: "Interreflections in Finite Cylinders," *J. Optical Society of America*, v. 31, pp. 223-233 (March 1941).
3. Moon, Parry: "Interreflection in Lightwells," *J. Optical Society of America*, v. 31, pp. 301-308 (April 1941).
4. Moon, Parry: "Interreflections in Rooms," *J. Optical Society of America*, v. 31, pp. 374-382 (May 1941).
5. Moon, P. and D. E. Spencer: "Light Distributions in Rooms," *J. of the Franklin Institute*, v. 242, pp. 111-141 (August 1946).
6. Moon, P. and D. E. Spencer: "Lighting Design by the Interreflection Method," *J. of the Franklin Institute*, v. 242, pp. 465-501 (December 1946).
7. Moon, Parry: *Scientific Basis of Illuminating Engineering*, McGraw-Hill Book Company, Inc., New York, pp. 57, 556-558 (1936).
8. Boast, W. B.: *Illuminating Engineering*, McGraw-Hill Book Company, Inc., New York, pp. 41-42, 74-75 (1942).
9. IES Committee on Standards of Quality and Quantity for Interior Illumination, Report No. 3: "The Interreflection Method of Pre-determining Brightnesses and Brightness-Ratios," ILLUMINATING ENGINEERING, Vol. XLI, p. 365 (May 1946).
10. Moon, P. and D. E. Spencer: *Lighting Design*, Addison-Wesley Press Inc., Cambridge, Mass., p. 27 (1948).

Know Your I.E.S. Officers

Starting on page 513 is a photo display of the Officers, Council, and the Section/Chapter Chairmen in the ten Regions of the Illuminating Engineering Society, for the year, 1955-1956.



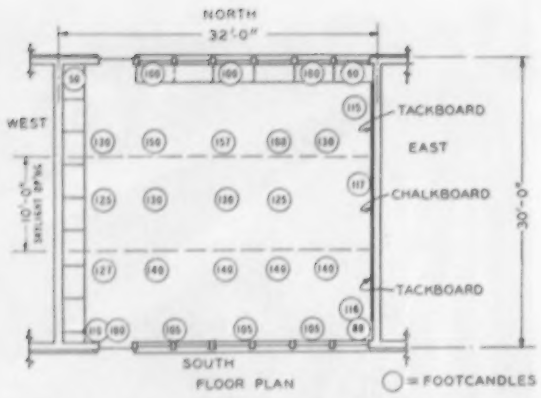
A field test has been made to study the development of a daylighting procedure which would use the best features of natural daylighting for a school classroom and, at the same time, remove the flaws inherent with most daylighting designs — glare, fluctuating levels of light, and excessive heat load.

New Approach to Roof Design for School Daylighting

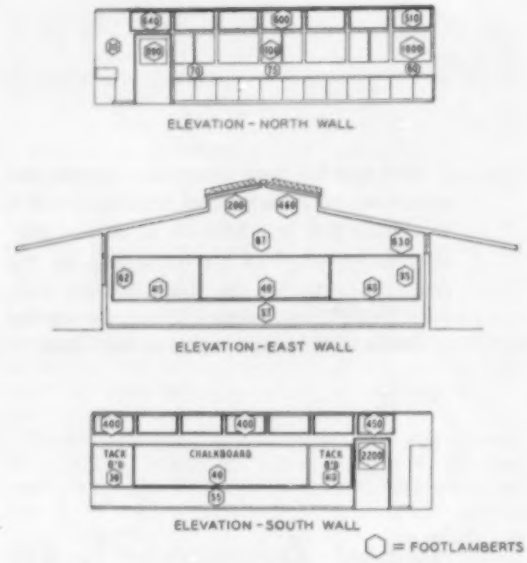
By F. H. LOGAN

FOR SOME TIME it has been our contention that the ideal environment for a child in a school classroom must include satisfactory seeing conditions in a complete 360-degree circle around him. This assumes that there will be no brightness exceeding approximately ten times the seeing task. Typical bilateral daylighting arrangements would not meet this requirement without extensive use of shading devices and other compromises. We feel another factor in good school environment, especially for the beginner, is the psychological transition from the home atmosphere to the impersonal educational interiors long typical of schoolrooms. A small child entering school for the first time may feel plunged too suddenly into a disturbingly foreign atmosphere. To overcome this psychological hurdle, we would advocate the use of a more residential scale in our primary grade designs. Such environmental shock would be reduced, we feel, if the child could move from home to a kindergarten and primary grade classroom of such a scale. An eight foot, or eight and a half foot side wall, and a ceiling height of not over ten feet could be used.

This installation won first prize in the contest for "My Most Interesting Lighting Job" conducted by the Golden Gate Section of I.E.S. AUTHOR: Daylighting Engineer, Western Asbestos Company, San Francisco, California.



Plan view, above, showing illumination in footcandles.



Elevations, right, showing brightnesses in footlamberts.

In Sacramento, California, The Superintendent of the Colusa Elementary School District, James Burchfield, and the firm of Barovetto and Thomas. Architects, decided to give this philosophy a practical field test. A school was designed with all of these problems in mind. Our inevitable conclusion, in studying to overcome what we considered basic flaws in conventional design, was that our source of daylight for the type of structure we had in mind would have to come from the top.

In addition, we would have to meet all the requirements of the I.E.S., American Standard Practice of School Lighting, as well as the additional requirements set up by the Division of Architecture and Division of School Planning in the State of California.

As seen from the picture of the classroom interior, cantilevered roof sections were used with a double-sloped, free-floating skylight in the center, running on the East-West Axis. The open area for the skylight took up the middle third of the ceiling area. From the exterior photograph, it is noted that a series of special matt-anodized aluminum baffles and Sun Gard louvering material were developed in a unique angle ratio. The baffles reflected sunlight through the louvered material and then downward into the classroom, while the same minor louvering structure diffused North light so that North and South light are basically equal in intensity.

In developing this procedure, we analyzed typical louvered structures and found that a child seated in one position in a classroom would have a full baffling effect from typical louvers in his peripheral range of vision, but that the same child seated in a different position in the classroom would have undisturbed North light passing through said louvers. Therefore, the minor louvered structure was added to the Northern exposure of the top light control, primarily for the purpose of breaking up and diffusing that objectionable contrast light.

The floor plan charts show the uniformity of footcandle readings throughout the classroom, and indicate that the brightness levels are amazingly consistent and controlled. We noted one important circumstance as readings were taken in this classroom. With an exterior North view giving us 1100 footlamberts, the contrast levels were not found objectionable in view of the high illumination levels within the classroom. One might say from this, that indoor-outdoor living and seeing has come close to a reality.

Electric lighting in this room is from recessed silver-bowl incandescent units, using 750-watt lamps. Since this school is not on double sessions, however, and is in the Sacramento Valley area where clear bright days predominate during the school year, the electric lighting system is designed to be purely supplemental.

INSTALLATION IN ST. LOUIS, MISSOURI.

Cove Lighting in a Two-Wall Kitchen

LIGHTING OBJECTIVE: To provide recommended levels of visually comfortable illumination in a long, two-wall kitchen without the use of ceiling-attached luminaires and to give the illusion of greater spaciousness.

GENERAL INFORMATION: This 8- by 17-foot kitchen has an 8-foot high white plastered ceiling. The walls are of yellow tile (about 65 per cent reflectance). The wooden cabinets have a reflectance of 35 to 40 per cent and the rose-colored counter tops about 40 per cent. The linoleum floor covering has a simulated random tile pattern in tones of brown. This long kitchen is arranged with the sink, range and refrigerator toward one end and a planning desk and eating bar at the other.

INSTALLATION: Instead of the usual furring above the wall cabinets, this space was used for a lighted cove formed by placing a 5-inch wide shielding board flush with the tops of the cabinets, and running full length down either side of the room. Because this kitchen is only 8 feet wide and the fluorescent tube centers are 10¼ inches away from the walls, these parallel coves appear to light the entire ceiling evenly and the room has a very airy and pleasant feeling. Four 40-watt preheat fluorescent lamps are used end-to-end in each cove. All lamps in the room are deluxe warm white color.

At the places where the cove passes over the sink, the range and the desk there are of course no wall cabinets. Here the cove has the effect of a luminous soffit because the bottom at these points is of Guth Gratelite louvers. At the sink and range the needed additional local lighting is provided by a 30-watt fluorescent lamp channel (Moe No. M4141) placed above the louver, forming a double row of fluorescent lamps in the cove (see Fig. 3).

For work counters on either side of the range, 20-watt shielded fluorescent units (H. & H. Fixture Company No. 120UC) are placed just beneath the cabinets at the wall. At the eating bar a 40-watt fluorescent unit is recessed in the bottom of the upper cabinet as shown in Fig. 4.

The footcandle readings, taken after over 100 hours of operation, and with all lighting turned on, are shown beside Fig. 2.

(over)

A.I.A. File No. 31-f

Cove Lighting in a Two-Wall Kitchen (Continued)

Location (see Fig. 2)	Footcandles
A	50
B	50
Range	52
Eating Bar	32
C	32
D	54
E	54
F	33
Desk	28
G	21
H	27
I	22

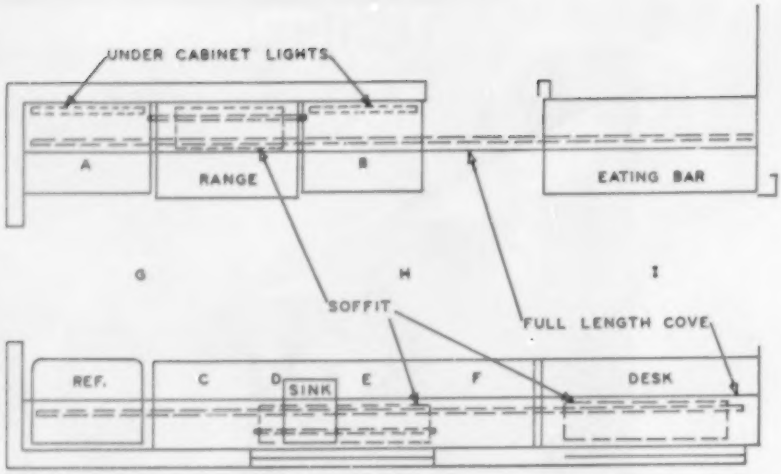


Figure 2. Plan view showing lighting equipment and locations at which illumination was measured.

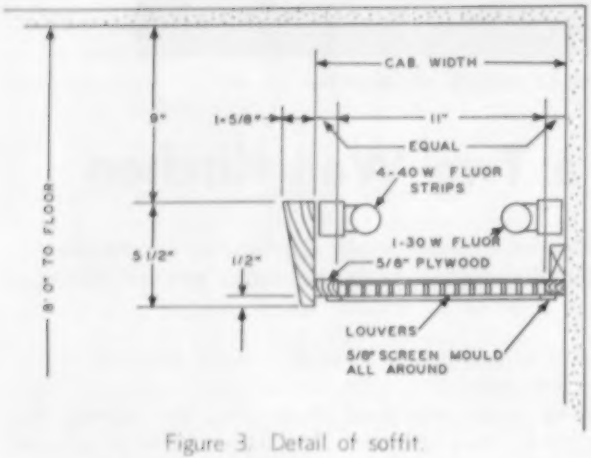


Figure 3. Detail of soffit.

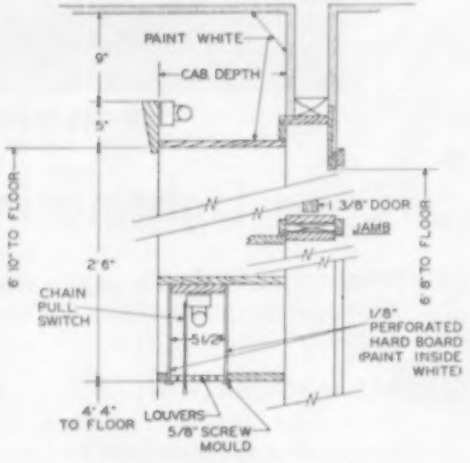


Figure 4. Lighting details at eating bar.

Figure 5. View of kitchen from opposite end

Builder: Marshall Berry, 2828 Brentwood Blvd., Brentwood, Missouri.

Lighting data submitted by Norman Raab, Union Electric Company, St. Louis, Missouri as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

10-55

Methods for Lighting Pictures In Residences

By EVE FREYER

PICTURES must be seen to be enjoyed. Those hung in residential interiors often require lighting in addition to the general room illumination to give them the importance and visibility they deserve. A portrait of Great-Aunt Bessie, a favorite watercolor, a collector's priceless oil painting, or the picture selected by the interior designer to complement the decor of the room, all are lost on the walls of a home unless they can be seen easily.

Many a picture-owner has sought to solve the problem of the picture that cannot be seen by purchasing something sold as a picture light in his local art or hardware store. These over-picture reflectors often are positioned such that they produce a bright spot at the top of the picture and little or no light on the lower part. Sometimes they result in a glaring image of the light source reflected from the shiny varnish of an oil painting or the glass covering a watercolor or fine print. Experience with over-picture reflectors producing these poor results has convinced many that they prefer their pictures unlighted even at the risk of being unseen. Fortunately, there are today many picture lighting devices available which do a good job, and there are several ways in which lighting equipment can be built into a room to illuminate the wall area on which a picture or a number of pictures are to be hung.

Since the object is to enhance the attractiveness and visibility of the representation hung on a wall, the lighting should not be uncomfortable, either because the light source itself is exposed to view or because its image in a shiny surface is re-directed toward an observer's eyes. The lighting should be as subtle as possible or practicable. The more elaborate systems require knowledge of the optics involved and custom-planning to put the light exactly where it is wanted.

The aim of this paper is to present types of equipment which can be used for picture lighting and a few simple ideas for custom-built installations, together with some concept of the distributions of light which they provide. Table I shows the footcandle distributions, in most cases over a test plane 28 inches by 40 inches, located as shown with respect to the lighting equipment. These measurements were taken to show the illumination *distribution* over the surface of a painting rather than absolute values of illumination. There can be no rigid standard of acceptability of uniformity of lighting on pictures since this is largely a matter of personal choice and depends on the size, subject matter, composition and coloring of the picture.

Most of the measurements were taken in a laboratory with a Luckiesh-Taylor brightness meter at right angles to chips of magnesium carbonate fastened to the test plane. Some readings were taken in the field with one color- and cosine-corrected cell of a paddle-type footcandle meter, and others with a brightness meter and target. Most of the field readings were taken over the surface of the picture (or wall in the case of wall washing units) actually lighted rather than on the 28- by 40-inch test plane used in the laboratory. The 28- by 40-inch dimensions were selected as typical of the maximum size picture likely to be found in most residences.

In the laboratory the test plane was oriented horizontally or vertically, whichever seemed better to show the maximum area which the unit might be used to light. Some units are not intended to light pictures as large as the test plane used. Each was placed where it seemed to do the best lighting job on the object to be illuminated within the room setting. The units evaluated in Table I were oriented in the laboratory in the same positions in which they are shown in the photographs, except where a non-optimum positioning for the photography was necessary because of architectural considerations. (For example, the molding predetermined the location of the picture in Fig. 8.)

Direction of Light

The angle at which light is directed on a picture becomes especially important when the picture has a shiny surface — glass, varnish, etc. As shown in Fig. 2 such surfaces reflect a glaring image of the light source at an angle equal to that of the light source from the picture surface. Such reflection always occurs when shiny surfaces are illuminated by sources of high brightness, but is apparent only to people whose line of sight is within the angular

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Residential Lighting Dept., Westinghouse Electric Corp., Bloomfield, N. J.

zone of reflection. Reflections visible only from positions in the room outside normal viewing angles are not objectionable. The light source itself should also be out of view for all the usual seated and standing positions within the room.

Another factor which must be considered in positioning the light source is the shadows produced by deep frames. Frames may cast shadows on the picture surface as well as on the adjacent wall. One large museum directs light at 30 degrees from the vertical as a compromise in minimizing frame shadows and directing specular reflection toward the floor (dog's eye view). For very deep frames (such as are often used on Corot landscapes) the museum has found it necessary to direct light on the pictures at 45 degrees although this may cause reflection difficulty (both mirror reflection of the source and a general veiling brightness) from viewing positions at 45 degrees. This museum considers 5 feet 6 inches as the average sight line (museums usually do not have to consider the seated as well as standing position, which complicates picture lighting in most homes).

Illumination Level

In picture lighting the illumination distribution over the surface of the picture is of prime importance, with actual footcandle level relatively unimportant. Subtle, low levels of lighting are desirable rather than a great contrast between picture brightness and that of the adjacent room surfaces. One criterion of some lighting designers who specialize in picture lighting is that the *picture should not appear to be lighted* at all.

The amount of light people want on pictures varies considerably depending on individual taste, the room illumination level, and whether the picture itself is light or dark. For example, the people who live in the house shown in Fig. 10 use a 15-watt lamp in the sphere, whereas to the author the unit is not satisfactory in this interior unless a 25-watt lamp is used. Similarly, the manufacturer of the unit shown in Fig. 9 recommends a 25-watt lamp, but a 40-watt seems necessary to the author to illuminate a picture as large as that shown.

It is recommended that all picture lighting devices be used in addition to the normal general lighting in the room. They are intended as supplementary, "effect" lighting. Few of them provide any general lighting, and most will appear unacceptably bright in very dark rooms. In addition, lighted pictures in dark rooms sometimes appear to be transilluminated and lose many of the qualities which the artist intended. Most of the photographs used to illustrate this paper were taken with some general illumination in the rooms.

The installation of dimmers in the circuit with wall-washing or optical projector units gives added flexibility; the lighting level can then be selected at any time to suit the mood of the picture or its owner, or to keep the lighting on the picture in balance with room illumination.

Color of Light

The color of light source used to illuminate a picture should be chosen with care to provide the effect desired.

Pictures have been lighted for many years either by natural daylight (the color quality of which changes considerably throughout any one day) or by incandescent lamps, which especially in small sizes produce a rather yellow light. Most art galleries today use a combination of light sources with different color qualities to provide an illumination which will be satisfactory for most pictures. However, in applications involving only one or two paintings one is free to choose the best color to bring out the effect desired in a particular picture — anything from bright sunlight to an overcast sky. If inside frosted or white incandescent lamps produce an objectionably yellow illumination for a particular picture, daylight lamps or a combination of daylight and ordinary inside frosted is recommended.

If fluorescent lighting is used, the deluxe colors should be chosen since these are designed especially to give better color rendition than the standard fluorescent source colors. Deluxe warm white should be used on pictures where it is desired to emphasize red and related colors; deluxe cool white enhances the appearance of greens and blues.

In very localized lighting applications such as picture lighting, any color difference between the local light source and the general lighting (to which the eyes are color-adapted) is likely to overemphasize the effect of the spectral distribution of the local light source on the area it illuminates. For example, a cool fluorescent lamp lighting a painting in a room with incandescent general lighting will make the picture look much bluer than the same picture would look with the same local lighting but with cool fluorescent general lighting in the room. Similarly, a low-wattage incandescent picture light will make a picture look much yellower during daylight hours than it will look at night when the eyes are color-adapted to incandescent lamp illumination.

"Non-glare" Cover Glass

There is available "non-glare" glass for use in framing pictures. These glasses are more costly

Photo courtesy of Wendel Artistic Lighting Corp.

Figure 1. The picture on the right is lighted by a conventional unit attached to the back of the frame. Note the high brightness on the top of the frame and spill light and shadow on wall in contrast to the evenly lighted picture on the left. The one on the left is illuminated by a concealed framed optical projector. This view is of a wall in a museum gallery, but both lighting methods find application in residences.

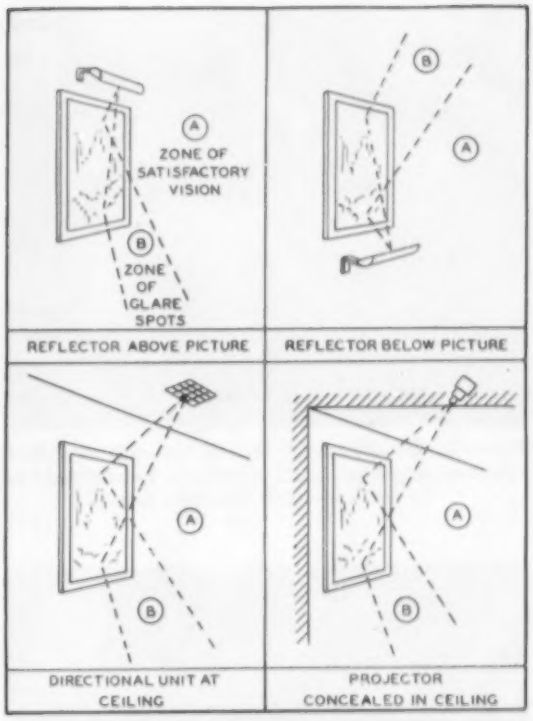


Figure 2. Glaring reflections of the light source will be visible in glass covered or heavily varnished pictures from viewing positions within zone B.

(Kelly, Thomas Smith: "Methods of Illuminating Art Objects and Pictures," ILLUMINATING ENGINEERING, April 1949.)

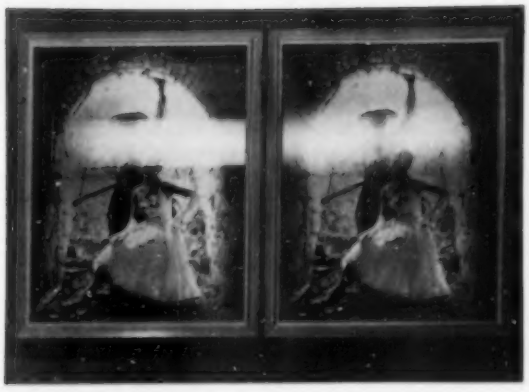


Figure 3. Note the mirrored image of the light source in the cover glass at the left and the improvement resulting from the use of "non-glare" cover glass on the picture at the right. To take this photograph the light source was located in a position to give the worst possible reflection. Few if any means of lighting pictures which might be used in a home would give as bad a reflection as this.

Figure 4. Conventional over-picture unit which fastens to back of frame. This 14½-inch two-lamp unit provides a good spread of light across the 25- x 30-inch canvas.

Figure 5. Lighted picture frames. In addition to illuminating the oil paintings, these units provide light on the wall above and below the frame.

Figure 6. Gold-finished box housing two 25-watt T-10 lamps is suitable for use on a piece of furniture or fireplace mantel. A similar 10-inch single-lamp box is also available.

Figure 7. Without localized picture lighting (left) this Rembrandt reproduction is scarcely distinguishable. (Light at the right and left sides comes from a pair of wall brackets over the ends of the long antique buffet.) The addition (right) of a louvered mahogany box (barely visible on the next-to-top shelf) containing two 25-watt showcase reflector lamps brings The Admiral's Lady to "life." See unit No. 9 of Table I.

than the usual picture cover glass but may make it possible to light pictures in locations where reflections from ordinary glass would render lighting impossible or very objectionable. These glasses are also applicable for pictures hung where reflections of windows are annoying and/or obscure the picture during the daylight hours. The glass shown on the right in Fig. 3 is slightly diffusing and may make some pictures look slightly fuzzy. Light incident on this glass at an angle close to the plane of the surface may cause a diffuse reflection which seems to veil the entire picture.

Another type of "non-glare" glass used in museums does not have the difficulties described above but has a delicate surface very easily damaged by ordinary handling (finger-prints, cleaning etc.) and therefore is probably not suitable for residential use.

Picture-attached Lights

Conventional over-picture lights which attach to the back of the frame are available in a variety of qualities and sizes. The wider the unit with respect to the picture, the better is the crosswise distribu-

Figure 8. Two-lamp mantel reflector with same contour as this manufacturer's conventional over-picture lights. Unit does a better lighting job when it can be used closer to the bottom of the frame.

Figure 9. Ceramic shield and reflector for standard A-bulb incandescent lamp. This unit comes in a wide variety of outside colors.

Figure 10. Black metal sphere with 25-watt lamp used on a grand piano to provide added light on a family portrait. The sphere can be tilted to any angle on the three-legged base. Inside is finished white.

Figure 11. Bent sheet-metal shield, painted to match mantel and wall, housing 15-watt T-8 fluorescent lamp and channel. This is a very simple, yet effective unit which could be made in a home workshop.

tion of light on the picture. (Some art galleries use units about as long as the canvas width.) A properly-designed reflector is necessary to distribute the light down over the length of the picture. Unit No. 5 in Table I contains lenses for further control of the light beam.

The better units are adjustable in (1) height above picture, (2) distance out from the picture, and (3) tilt of reflector with respect to plane of picture. This flexibility enables one to adjust the light to give the best effect from the angle at which the particular picture is usually viewed. Units which are too small or not sufficiently adjustable often give only a spot of glaring brightness near the top of the picture. High brightness on the top frame should be avoided, and if possible, the unit should be high enough so not to obscure the upper part of the frame.

When building or redecorating a room in which pictures are to be used in permanent positions with conventional over-picture lights (or the lighted frames described later) it is desirable to

Figure 12. Brass planter behind which is located a 40-watt lumiline lamp to light the old print.

Figure 13. A, above, brass portable spot light containing an R-12 20-watt reflector lamp. This unit comes with a separate 28-volt transformer, located here on the floor near the convenience outlet; B, below, similar unit painted to match wall on which it is mounted.

locate convenience outlets on the wall where they will be covered by the pictures. This obviates electric cords dangling from beneath the lighted picture (as shown in Fig. 4).

Many people object to hanging a light over a picture, although such units when finished to match wall or frame are not conspicuous relative to the lighted picture, especially if the unit is mounted high enough not to obscure the canvas or matte area. Large units with good light control, such as that shown in No. 5 of Table I, may sometimes be lined up for the usual line of sight with a horizontal architectural element in an ornate room, and therefore rendered far less obvious.

Lighted Frames

Lighting integral to the frame is yet another solution to the picture-lighting problem. There are several styles of such frames available in a few stock sizes, and one manufacturer will custom-make them in any size. This type of frame, illustrated in Fig. 5, is really a double frame with lumiline lamps above and below the picture. The lamps are positioned to give a fairly even distribution of light from top to bottom as well as an equal amount of illumination on the wall above and below the frame. This adds to the general lighting in the room and can be sufficient for some casual seeing tasks such as reading in bed for short periods of time. The minimum frame size (governed by lamp size) is approximately 12 x 16 inches inside dimension, and the maximum inside vertical dimension recommended is 24 inches. The illumination distribution from top to bottom might be objectionably non-

uniform with longer paintings and the present frame design. A three-way switch makes it possible to operate either the upper or lower light alone or both simultaneously.

Devices to Light Pictures from Below

There are several devices on the market which can be placed on a mantel shelf or piece of furniture to light a picture from below. Figs. 6 to 10 show several units of this type.

Figure 14. Fireplace mantel with recessed 40-watt fluorescent lamp covered by diffusing glass.

Photo by Hedrich-Blessing, Chicago.

Figure 15. The pictures displayed on the shelf in this collector's living room are changed frequently. The 150-watt reflector lamps in bullet housings can be directed at any desired angle to the wall area. The strip to which these units are attached contains fluorescent lamps which provide indirect lighting.

Figs. 11 and 12 show two simple custom-made devices similar to those described above. The one shown in Fig. 11 uses a 15-watt fluorescent lamp which gives approximately the same lumen output as the two 25-watt tubular incandescent filament lamps shown in Fig. 8. The 40-watt, 12-inch lumiline lamp used in the installation of Fig. 12 gives about three-fourths as much light initially.

Fig. 13a shows a brass-finished spot light with soft-edged beam which is attractive when placed on a tabie or mantel shelf.

Since the most important picture in a room is often hung above the fireplace, normally a dark area, a light box is sometimes recessed in the mantel shelf. This is not a difficult construction problem even in houses already built because the mantel shelf is usually a flat board fastened above a hollow space. Fig. 14 shows a simple fluorescent lamp and diffusing glass installation in a small house. To obtain better distribution directional lenses similar to those shown in Fig. 22 might be recessed in the mantel.

Some landscapes in which the artist intended a bright sky and darker ground look strange when illuminated from below in a non-uniform manner such that the bottom of the picture is much lighter than the top. However, locating the light source below usually positions the zone of reflected glare above the picture where it is never visible.

Photo by F. M. Demarest, New York.

Figure 16. The three scoop units lighting this tapestry each contain a 150-watt PAR-38 projector lamp and a spread lens. These units are spaced 18 inches apart and are two feet out from the wall.

Spotlights

One or a number of pictures may be lighted by standard incandescent reflector-type lamps in sim-

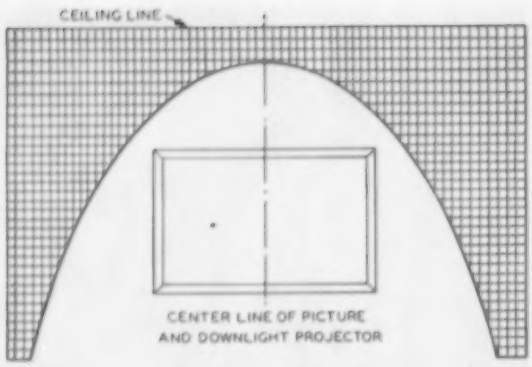


Figure 17. Any optical projector recessed in a ceiling and directed toward a wall produces a beam pattern on the wall similar to that shown. The picture to be lighted must fit within the beam pattern. Wide pictures close to the ceiling cannot be lighted with a recessed projector; if the top corners of the picture extend out beyond the beam the picture must be lowered to fit within the limits of the light beam. The framing shutters in the unit are used to cut off the light which would fall on the wall outside the picture.

Figure 18. Optical projector recessed in ceiling is shuttered to light only the canvas of this oil painting.

ple bullet-shaped housings with adjustable sockets as shown in Fig. 15. Fig. 16 shows an installation in which the suspended units lighting the wall-hung tapestry were specified by the interior designer to be conspicuous and to emphasize the height of the wall they illuminate.

Optical Projectors

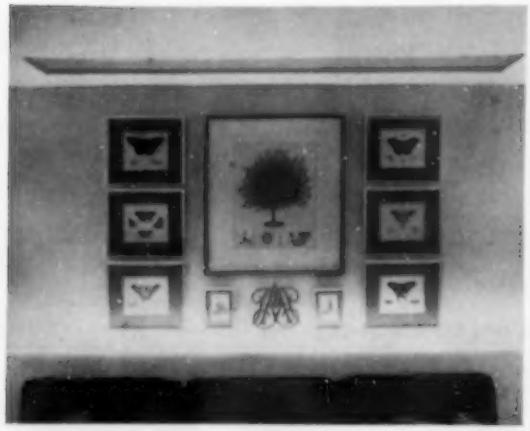
The most subtle but a complex method of picture lighting is to use an optical projector with shutters so no light falls outside the canvas or picture frame. These units, first imported from France about 1929, are available in a range of sizes and degrees of complexity. The longer the "throw" required, the more bulky the equipment. With such a precise optical system, replacing a lamp (and lamp life is usually shortened due to heat when the units are recessed) sometimes requires refocusing and readjustment of the shutters. The smallest unit uses a 75- or 100-watt G-16½ lamp and requires a space above the ceiling 9½ inches in diameter and 8 inches deep. Ceiling apertures for recessed units vary from one to three inches in diameter, depending on the optics and geometry. The ceiling plate shown in Fig. 18 has an oval aperture 1 by 1⅞ inches.

Because of the optical elements involved, it is generally desirable to send the manufacturer a sketch of the area in which one desires to install such a light, showing dimensions of picture and the distance from the ceiling to the top of the frame, as well as any obstructions in or above the ceiling which might limit the placement of a recessed unit. The better units come with a device to lock the framing shutters in position so that a vibration or jarring will not move them. It is recommended that pictures to be lighted by optical projectors be securely fastened flat against the wall, not tilted.

To improve efficiency, especially with long throws, it is essential to use condensing lenses, of the power necessary for the particular application. With some paintings a sharp cut-off of light at the edge of the canvas is preferable, whereas the overall effect with others is enhanced by giving a "soft" edge to the beam.

In installing optical projectors to light pictures

Figure 19. This cornice conceals a row of fluorescent lamps which provide some light down on the framed prints.



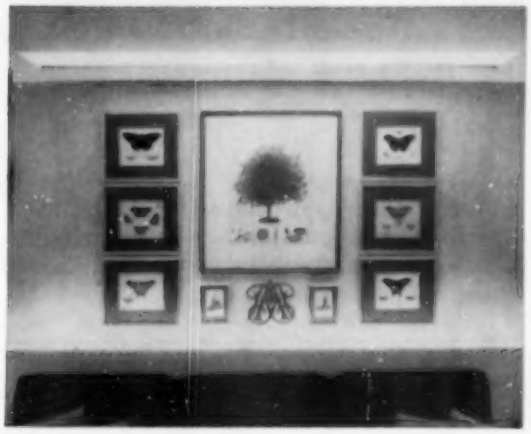


Figure 21. The lens strip concealed by the bronze box above the painting washes the wall area with light. See unit No. 21 in Table I.

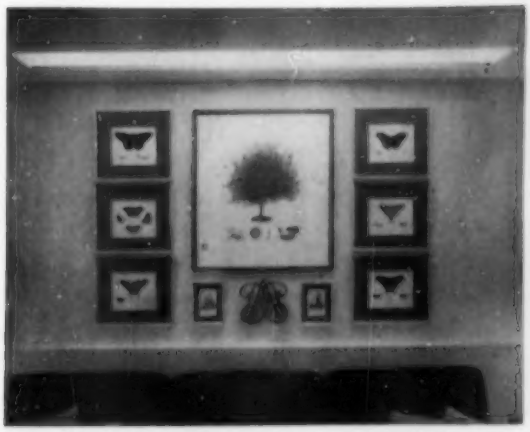


Figure 20. Pictures lighted, A, above left, from ledge behind davenport; B, above, from fluorescent lamps in ceiling soffit; C, left, from both below and above.

covered by glossy varnish or glass it is important to consider the area of reflected glare which mirrors the incident beam of light. The simplest installation for the amateur is to install the projector so the light is incident from above at 45 degrees. This eliminates most glare, although it is not as good as units more carefully installed off to one side with the reflected light calculated to fall to some little-used or non-traffic area of the room. Unless a simple 45-degree mounting and a short-throw are possible, the optical problem becomes difficult for those not well-versed and experienced in the custom-design and adjustment of this equipment.

Although the tendency is to recess units, with the attendant problems of heat, relamping (from room above, or from below by removing ceiling plate) and necessary clearance, several optical units are available which can be placed on a table, in a bookcase, or on top of a high piece of furniture.

Pictures hung above fireplaces are difficult to light by optical projectors if the picture extends close to the ceiling. (See Fig. 17.) Many awkward locations are impossible to light other than by using a mirror to change the direction of the beam of light. Some of the custom-designers employ such devices but they require frequent cleaning (every three weeks or so in most residential interiors) since the mirror glass collects dust and smoke very readily, greatly reducing the already low efficiency of the lighting system.

Wall Lighting

If a number of paintings are to be hung on one wall sometimes the entire wall is lighted. In these

Figure 22. Wall area with three pictures lighted by rectangular lens units recessed in ceiling.

Figure 23. The plants and glass-covered watercolor on this den wall are lighted by three 100-watt "wall-washing" units recessed in the ceiling.

Figure 24. Dining area wall on which is hung artist's model designed for a project of the architect-owner. Wall is lighted by three 150-watt "wall-washing" units. These units are spaced three feet apart and 18 inches out from wall; manufacturer recommends spacing 3½ feet apart and 3½ feet out from wall. Units are dimmer-controlled in this installation.

installations it is especially important that the pictures hang flat against the wall. Very deep frames may cast shadows on the pictures with this highly directional lighting; if pictures must have deep frames wall lighting will probably be unsatisfactory.

A wall may be lighted simply by a valance or ceiling-attached cornice (Fig. 19), or built-in light box below, or combination of the two for greater uniformity from top to bottom (Fig. 20). The use of lenses in such construction will improve light distribution. Fig. 21 shows one application of a commercially available lens strip.

There are available several designs of "wall-washing" units constructed to give fairly uniform lighting from top to bottom. Figs. 22 to 24 show several examples of installations of such wall-washing equipment. The manufacturer in each case recommends the spacing out from the wall and distance between individual units for uniformity of wall illumination. Wall lighting units are costly and of relatively low efficiency.

Acknowledgments

Without the constant help of Miss Myrtle Fahsbender, who suggested the topic originally, this paper would not have materialized. Thanks also are due to Miss Priscilla Presbrey for her helpful criticisms, to Miss Stella Fetzer of the Cincinnati Gas & Electric Company for photographs and illumination data on the installation shown in Fig. 20, to Mr. Kerr Sanders of the Chicago Lighting Institute for Fig. 15 and to Miss Bertha Schaefer, Interior Designer, for Fig. 16. I wish to express appreciation too for the cooperation of the following in providing information and equipment for this study: Stanley McCandless of Century Lighting, Holophane Company, Thomas Smith Kelly, Robert A. Langer of Kliegl Brothers, Lightolier, Northern Light Company, Rambusch Decorating Company, Richardson Reflector Company, and Wor-de-Klee, Inc.

TABLE I.

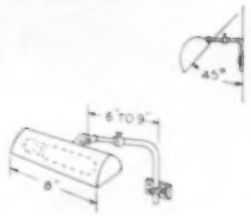
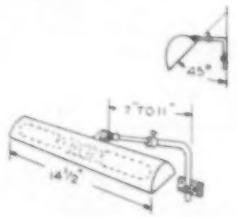
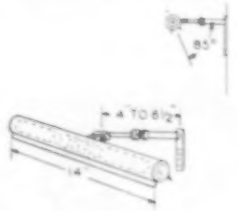
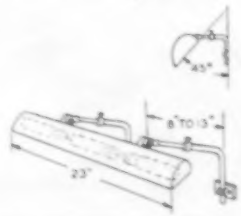
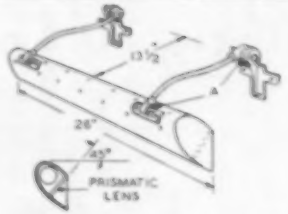
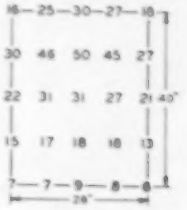
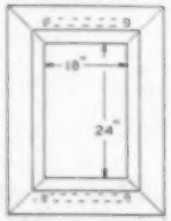
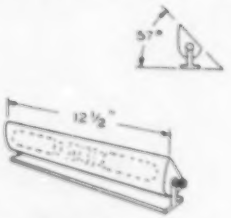
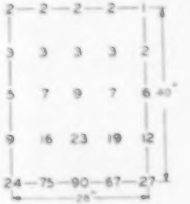
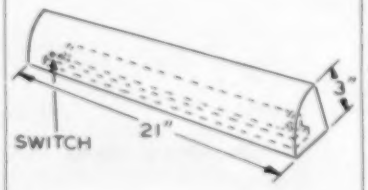
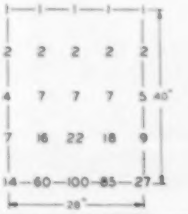
Unit No.	Sketch of Lighting Unit	Description	Lamp Used	Location of Unit	Illumination Distribution (Ft-c on Vertical Surface)	See Fig. No.	Comments
1		Single-lamp conventional over-picture unit with ribbed specular reflector.	25-watt T-10, inside frosted.	Angle as indicated; lamp 10" out from wall; top of reflector 4" above top of test plane.			Adjustable in height above frame, distance out from picture and tilt with respect to plane of picture.
2		Two-lamp conventional over-picture unit with ribbed specular reflector.	Two 25-watt T-10, inside frosted.	Angle as indicated; lamp 12" out from wall; top of reflector 4" above top of test plane.		4	Reflector contour same as #1; adjustability similar to #1.
3		Two-lamp conventional over-picture unit with specular reflector.	Two 25-watt T-10, inside frosted.	Angle as indicated; top of reflector 7⅜" from wall and 3" above top of test plane.			Adjustable in distance out from picture and tilt with respect to plane of picture. Vertical adjustment provided by choice of mounting bracket holes.
4		Three-lamp conventional over-picture unit with ribbed specular reflector.	Three 25-watt T-10, inside frosted.	Angle as indicated; lamp 14" out from wall; top of reflector 5" above top of test plane.			Reflector contour same as #1 and #2; adjustability similar to #1.

TABLE I. *(Continued)*

Unit No.	Sketch of Lighting Unit	Description	Lamp Used	Location of Unit	Illumination Distribution (Ft-c on Vertical Surface)	See Fig. No.	Comments
5		Over-picture unit with lenses.	Four 40-watt A-19, inside frosted.	Angle as indicated; center of lenses 14½" from wall and 2½" above top of test plane.			Unit comes in any multiple of 6½". Position of reflector adjustable at locations A.
6		Lighted frame.	Two 18" lumilines; one above, and one below picture.	Integral to frame.		5	Smallest size frame available is 12" x 16" inside dimensions; maximum height is 24"; lumiline lamp sizes as required to fit width.
7		Two-lamp mantel-top unit with ribbed specular reflector.	Two 25-watt T-10, inside frosted.	Angle as indicated; outer edge of base 11½" from wall, 6" below bottom of test plane.		8	Unit designed for use under picture; reflector contour same as #2. Can be tilted 150 degrees.
8		Custom-built bent sheet metal housing for 15-watt fluorescent lamp on ⅞ x 1¼" channel.	15-watt T-8, deluxe warm white fluorescent.	Outer edge of unit 11" from wall; bottom 6" below bottom of test plane.		11	

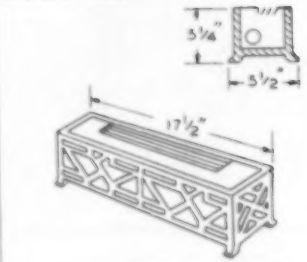
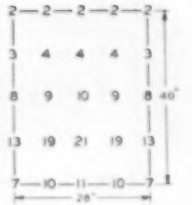
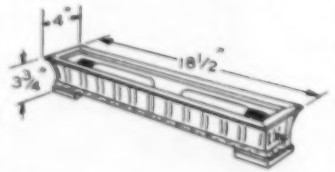
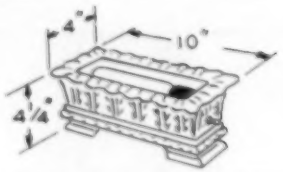
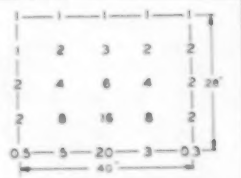
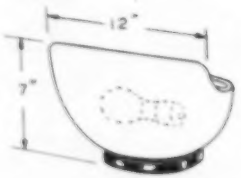
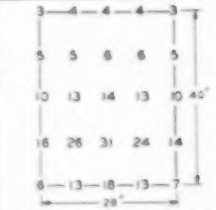
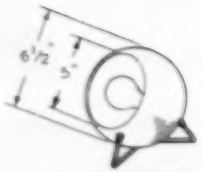
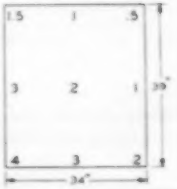
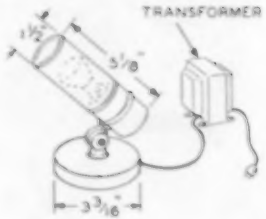
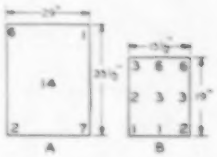
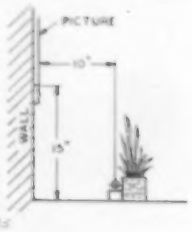
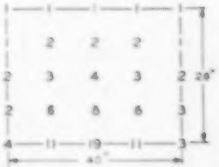
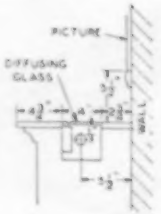
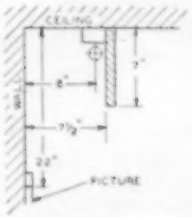
9		Mahogany box, louvered top.	Two 40-watt T-10 showcase reflector lamps.	Center of box 15" from wall; top of box 10" below bottom of test plane.		7	Interior of box is black.
10		Gold-finished box, open top.	Two 25-watt T-10, inside frosted.	Outer edge of box 8" from wall; top 8" below bottom of test plane.		6	Interior of box is white.
11		Gold-finished box, open top.	One 25-watt T-10, inside frosted.	Outer edge of box 8" from wall; top 8" below bottom of test plane.			Interior of box is white.
12		Ceramic shield.	40-watt A-19, inside frosted.	Front edge of unit 15½" from wall and same height as bottom of test plane.		9	Unit comes in a variety of colors. Inside is white.
13		Metal ball.	25-watt A-19, inside frosted.	End of lamp 42" from center of canvas.		10	Unit comes white or black outside finish. Inside is white. Can be tilted to any angle in any plane.

TABLE I. *(Continued)*

Unit No.	Sketch of Lighting Unit	Description	Lamp Used	Location of Unit	Illumination Distribution (Ft-c on Vertical Surface)	See Fig. No.	Comments
14		R-12 spot light.	20-watt 30-volt R-12 single contact bayonet base; lamp operated on 28 volts from transformer.	a. End of tube 26" from center of picture. b. End of tube 41" from center of picture.		a. 13a b. 13b	Unit comes in brass with base as shown for use on table or mantel, or gray with plate for wall or ceiling mounting.
15		Lumiline strip behind brass planter.	40-watt white lumiline.	As shown.		12	Brass planter shields lumiline lamp and its wiring channel. Channel is placed directly behind planter box.
16		Fluorescent lamp recessed in mantel.	40-watt deluxe warm white.	As shown.		14	
17		Cornice.	One 40-watt deluxe warm white fluorescent.	As shown.		19	Single length cornice section; normally used in multiples.

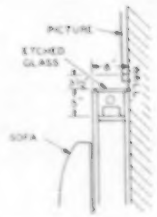
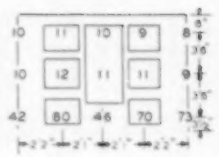
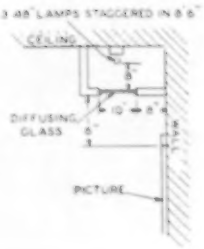
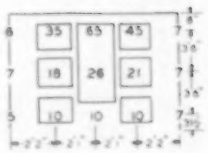
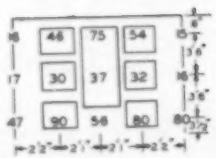
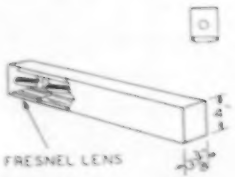
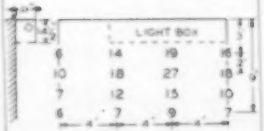
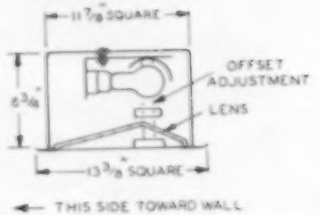
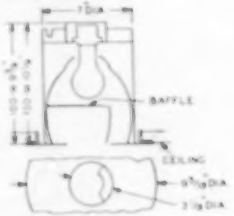
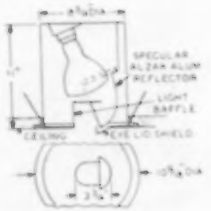
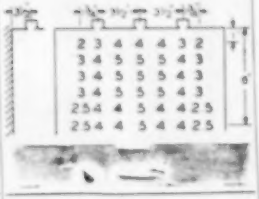
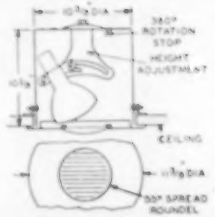
18		Ledge lighting.	One 14-watt, one 20-watt, and two 40-watt deluxe cool white fluorescent end-to-end	As shown.		20a	
19		Soffit lighting.	Three 40-watt deluxe cool white fluorescent.	As shown.		20b	
20		Ledge plus soffit.	See #18 and #19 above.	As shown.		20c	Combination of #18 and #19.
21		Lens strip 8' long.	Sixteen 40-watt T-10 showcase reflector.	As shown.		21	Lens is 6" long; strip can be ordered in any length which is a multiple of 6".

TABLE I. *(Continued)*

Unit No.	Sketch of Lighting Unit	Description	Lamp Used	Location of Unit	Illumination Distribution (Ft-c on Vertical Surface)	See Fig. No.	Comments
22		Wall washer.	150-watt A-23, clear.	15" out from wall on 2' centers.		22	
23		Wall washer.	100 watt A-21, inside frosted.	18" out from wall on 2' centers.		23	Ceiling aperture is 3⅛", through which lamp can be replaced and baffles inserted, removed, and adjusted. Unit can be adjusted for either 100-w A-21 or 150-w A-23 lamp.
24		Wall washer.	150-watt R-40 flood.	3½' out from wall on 3½' centers.		24	Eyelid shield projects below ceiling as shown.
25		Wall washer.	150-watt PAR 38 flood.	36" out from wall on 4' centers.			Convex lens 5⅝" in diameter projects slightly below ceiling line.

DISCUSSION

R. A. LANGER:* Miss Freyer is to be commended for undertaking a study of a segment of the lighting field which has always been fraught with controversy and confusion. She has quite successfully encompassed the subject and the technical information she has compiled provides much valuable comparison data which has, heretofore, been unavailable.

Very little in the way of additional material can be added and the following comments are offered to lend emphasis to the more important considerations and to add a few items gleaned from experience.

(1) Lighted pictures create dramatic interest in a room and such lighting should not be treated as luxury. Its cost should be considered in terms of the added living pleasure it will provide.

(2) Relatively uniform distribution of the light over the picture area is of much greater importance than is the intensity. An exception to this principle frequently exists with murals and tapestries where a figure or some grouping requires additional emphasis. Very soft edge equipment is then used to superimpose the additional light so that the viewer is not aware that the visual effect has been subtly added by means of light. Dark pictures will, of course, require more light than a light pastel. Most equipment designed for picture lighting will accommodate several sizes of lamps and the final decision of wattage should be made experimentally after the installation is completed.

(3) Almost without exception pictures can be successfully lighted from above. Lighting from below should only be attempted as a last resort and after study to determine whether or not a grotesque effect may be created.

(4) Where wall areas surrounding a picture will also be illuminated by the same source, care must be exercised in selection so that the light beam pattern is soft edged. Equipment which produces a sharp edged light beam or a scallop on the wall above the picture should never be used since the resultant brightness contrasts will introduce a note of disharmony with the overall effect.

(5) Color, in the form of filters, can frequently be added to the lighting to enhance a picture. Purists will not agree with this premise. Since the picture is being lighted to provide viewing pleasure, it seems only logical that such "tampering" with the artist's impression should be permissible if the effect is improved. An example of a painting so treated featured a snow capped mountain top at sunrise. A very pale straw filter brought the picture to dramatic life.

Great care must be exercised in using filters and only pale tints may safely be used. The newer plastic filters which are available in sheet form provide a range of tints never previously available in glass.

This technique is necessary restricted to optical projectors where the light can be confined to the picture area. Colored light falling on a wall surrounding the picture would immediately make the "improvement" obvious.

(6) Optical projectors have definite limitations on maximum beam spread and it is frequently impossible to light a very large picture over a mantle from such a device recessed in the ceiling.

In such a case, a portable projector might be located in an inconspicuous place in the room. A very recent development has been the use of wallwasher downlights for this application. The technique involved requires painting out with a velvet black flat paint all of the reflector surface except that part redirecting light to the painting. The resultant light pattern maintains uniform lighting over the picture and tapers out to a very soft edge on the walls.

Manufacturers of this equipment will, upon request, recommend the most suitable locations. A request for this assistance should include all pertinent physical dimensions of the room and should also indicate, if possible, the planned furniture arrangement. This last information will enable the manufacturers' engineers to locate the equipment so that reflected glare will be in the least objectionable room sector.

*Chief Engineer, Kliegl Bros., New York, N. Y.

Discussion of Conference Papers

Written discussion on any of the technical papers presented at the I.E.S. 1955 National Technical Conference should be submitted immediately for publication with the paper in ILLUMINATING ENGINEERING.

Send: One copy (original) to Miss Ruby Redford, Editor, ILLUMINATING ENGINEERING, 1860 Broadway, New York 23, N. Y.

One copy to Mr. H. F. Davidson, Vice-Chairman, I.E.S. Papers Committee, Hydro-Electric Power Commission of Ontario, 620 University Avenue, Toronto, Ont.

One copy to the author of the paper.

One copy to Session Discussion Organizer.

Bank Lighting With a Premium

STRAIGHT INTEREST — High-level quality lighting for performance of visual tasks.

EXTRA DIVIDEND — Advertising display of modern bank illuminated until midnight.

GOOD LIGHTING is not exceptional in banks. But a high-level installation that does double service in advertising the bank at night is a credit for any financial institution.

Effective display and 80 footcandles interior illumination are achieved at the San Fernando Valley Federal Savings and Loan Association, Van Nuys, Calif., with a luminous ceiling installation covering 8250 square feet. Indoors the ceiling is of corrugated vinyl plastic; corrugated Plexiglas is used for the exterior overhang over the sidewalk. Mounted in rows 30 inches on centers, 759 48-inch T12 cool white fluorescent lamps are located 14 inches above the plastic in a 3-foot plenum.

Illumination levels inside the bank average 82 footcandles and in the outdoor area, 52 footcandles maintained.

At the outer edge of the roof, a system of vertical louvers prevents direct sunlight from entering through the glass walls of the modern building. The louvers are automatically re-positioned throughout the day by means of a time switch.

Since the lighting is in operation every evening until midnight, it achieves its double purpose of providing interest and appeal as an advertising display.

Photos and data courtesy Department of Water and Power, City of Los Angeles.

Quantity and Quality of Interior Illumination

Discussion of "Quality of Lighting" by S. K. Guth and "Use of Performance Data to Specify Quantity and Quality of Interior Illumination" by H. Richard Blackwell.

(Published June 1955 issue of ILLUMINATING ENGINEERING.)

L. C. KALFF:* The Quality and Quantity Session of the 1954 I.E.S. Conference at Atlantic City left me rather dissatisfied. I certainly have great respect for all the work done by the lighting experts studying these problems, but the more I think it over the deeper I am convinced that they are on the wrong track.

Speaking about this with friends, I made the following comparison which certainly — like all comparisons — is not 100 per cent correct but which may all the same give some food for thought.

Every good cook must be interested in her work and will enjoy preparing a good soup, trying out new recipes and variations, changing the quantities of the ingredients or adding new flavors. We have the privilege of having such a good cook at home but we also know that there are millions of housewives who do their cooking as well and who are in that respect as creative as our cook. We are convinced that there are many more creative talents in the world than we generally think.

Now, when listening to the lectures of Mr. Blackwell and Mr. Guth [June 1955 I.E.], I thought of our cook at home and how infinitely more simple it seems to be for her to find a recipe for a delectable soup than it must be for scientifically trained men, be they chemists or medical men or dieticians, to find something of the same culinary merits even in the most perfect laboratory.

Mr. Guth would probably start his studies with plain water, heating it up and asking his observers to give their opinion when it was "unbearably" hot, when "uncomfortable" and so on, till 50 per cent of the observers would declare that they just can stand the temperature. The other 50 per cent would still burn their mouths, but at any rate the BCD would be found.

Mr. Blackwell would now add infinitely small quantities of salt to the hot water and ask several people if they taste the salt or not. From their statements he would make graphs and start calculating. This work might last five years and after that he would add some more salt or even some pepper and start all over again.

It seems to me that this approach which tackles the simplest and most obvious parts of the total problem first, would yield less and less results when the more subtle problems of flavors and their combinations would have to be studied, asking for more and more complicated formulae and calculations.

The final result — if the study would be crowned with success — would be a "Chinese" copy of the excellent soup our cook had prepared many years before instead of a tempting new recipe.

I started to write these remarks with a rather hard pencil on glossy paper: the words were hardly visible. Not having the scientific attitude I did not take a still harder pencil in order to find out if the writing would become completely illegible. I took a soft pencil so that now my thoughts are clearly visible in black and white.

H. L. LOGAN:* Dean Farnsworth's comparison of the speakers on today's program [the Session on Quantity and Quality at the 1954 I.E.S. National Technical Conference] with explorers going out into different areas and bringing maps back they cannot quite fit together is quite apt. If each "map" were perfectly complete, so that it exactly fitted the maps of all the other newly explored "areas," life would be rather dull. It would mean that all was known, and there was nothing new to be discovered. As the three papers are fundamentally concerned with different aspects of human behavior in response to visual stimuli it is safe to predict that this uninteresting sequel is not likely to come about for a long time.

In listening to Dr. Guth's able and interesting presentation the writer is reminded of the importance of transitional zones in brightness contrast and of Mr. L. C. Kalff's penetrating observation that "too little contrast can be as tiring as too much."

The writer is inclined to join Mr. Kalff[1] in a "middle of the road" position between the laboratory viewpoint that treats human beings as statistics, and the artistic viewpoint that recognizes no common statistical denominator but only the uniqueness of the individual. The writer agrees with Mr. Kalff that "really unacceptable glare" should be avoided, but also believes with him that glaring conditions are not necessarily bad. Mr. Kalff's comment about glare in firework displays as "even very nice" is quite apt. So is the glare from table silver and all other glare that is legitimately part of an artistic design. This is excluded from our present thinking on visual comfort but sooner or later will have to be brought in.

Also, there is another aspect to the present tendency to rigid thinking on this subject, which is that "glare" or lack of "glare" is, to a larger extent that some lighting engineers may have realized, a matter of mood, attitude or blissful ignorance as well as a matter of physiological reality. This is borne out by the current evidence of Hopkinson and Petherbridge[2] indicating that 85 per cent of the general population would be satisfied with a visual situation that would be acceptable to only 50 per cent of trained laboratory observers.

There is, unquestionably, a hard core of glaring situations

*General Art Director, N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands.

*Vice-President in Charge of Research, The Holophane Co., New York, N. Y.

that would not be modified by mood, attitude or ignorance, nor compensated for by the keener vision which is the bonus of some milder glaring situations; but present methods of evaluation attempt to cover a much wider range of the situations than "hard-core" type and in so doing set up standards that artificially penalize the designer of lighting installations.

No method of glare evaluation can be ultimately satisfactory that sets up standards more severe than those built into the average lay observer. The mechanical detail of making the present methods work better may lie in selecting the proper equivalent for the adaptation level. Both the Guth and the Harrison-Meaker methods use an equivalent that gives results lower than check with growing field experience. The field experience the writer refers to is the day-to-day experience of the field engineers of two large organizations in the lighting field whose reports show repeated instances where users express a higher degree of comfort satisfaction than is predicted from present comfort tables. The fact that Hopkinson and Petherbridge report lay observers to be less responsive to glare than trained observers hints that this phenomenon is rather universal.

The Logan-Lange method uses the mean field brightness (which was used in Guth's experiments) as the equivalent of the adaptation level. Its predictions are somewhat less severe than those of the other two methods, particularly with diffusing equipment; but increasing experience leads the authors to suspect they also are more severe than the fact.

One thing is certain, whatever place in lighting practice is finally achieved by visual comfort methods, they will only be one detail in the omnibus visual evaluation that is needed and which the eye makes when it views a luminous environment. This omnibus visual evaluation is what Mr. Kalff has in mind when he says "The study of the visual field and the brightness thereof should include the whole human field as we see it."

With reference to Dr. Spencer's comments about basing visual comfort evaluations on the horizontal line-of-sight the central fact is the statistical frequency of various lines of sight. The structural characteristics of man force the line-of-sight to hover around the intersection with the horizon in natural view-fields for survival reasons. Artificial fields are constructed to fit man's characteristics and induce similar lines-of-sight, namely from about 10 degrees above the horizon to about 30 degrees below, in a horizontal band through 360 degrees. The statistical frequency of lines-of-sight engaging the lighting units is low, owing to the muscular discomfort involved in looking in such directions, to the lack of survival necessity to indulge such views, and the inherited repulsion to unguarded looking in such directions caused by encountering the intolerable sun in natural fields.

Dr. Guth neglected to mention the flux system of evaluation[3] in his report on Quality in Lighting and confined his comments to methods of evaluating visual discomfort. Quality is much more than visual comfort or discomfort. In the final analysis a visual field of highest quality is one to which normal people are fully adapted. Going back to Mr. Kalff's conviction that evaluation "should include the whole visual field as we see it," the flux method is a start in that direction. It presents the visual field as we see it, and analyzes it on the basis of the degree of its approach to or departure from optimum natural fields. It is not a simple system but neither is the complex it deals with, and ignoring it will not cancel the facts.

References

1. Kalff, L. C.: "Environment in Seeing," ILLUMINATING ENGINEERING, Vol. L, No. 7 (July 1955).
2. Hopkinson, R. G. and Petherbridge, P.: "Two Supplementary Studies on Glare," *Transactions I.E.S. (London)*, Vol. XIX, No. 7 (1954).
3. Logan, H. L.: "Light for Living," ILLUMINATING ENGINEERING, Vol. XLII, No. 3 (March 1947).

DOMINA EBERLE SPENCER:* The term, *visual comfort index*, suggested by Dr. Guth has a rather attractive sound. It might be most interesting to be able to tell "how many of the observers would be expected to be visually comfortable with a given combination of environmental conditions." There are, however, several restrictions on the valid application of such a term which I shall discuss briefly.

(a) *Comfort Definition.* The greatest difficulty associated with the word comfort is that, while everyone has a vague notion of its meaning, the term has no precise definition. As applied to the BCD data, for example, the visual comfort index would presumably be related to the response of human subjects to the flashing-light sources employed in the basic BCD experiments. But Dr. Guth has not been able to point to any data which prove that the reactions of subjects to flashing luminous environments, with the large areas and high levels characteristic of modern lighting designs, are correlated in any way with human reactions to non-flashing luminous environments. If a visual-comfort index tells us what percentage of people will be comfortable under a lighting system that is set to flashing in a specific way, it has no meaning for practical lighting design.

(b) *Line of Sight.* Assuming that a significant definition of visual-comfort index can someday be found, how should it be applied? At present, where employed, visual comfort indices are calculated for an observer with horizontal line of sight, which is sometimes taken parallel to the fixtures, as well as perpendicular to them. The assumption seems to be that comfort is only important when people are relaxing and that in moments of relaxation, the eyes are always fixed on the middle of the opposite wall.

In the first place, the assumption of a fixed line of light has no physiological basis. Tests on the eye motions of human beings show that the line of sight is continually changing. In fact, Dr. Riggs has shown that without motion vision is impossible and that with exaggerated motion vision may be improved.

If an adequate visual-comfort index can someday be established, it must be applied, not to one or two lines of sight, but to *all possible lines of sight and to all possible sequences of eye motions.* Thus, for a given luminous environment, the number of people who would be uncomfortable if they stared at the darkest or brightest regions might be given, as well as VCI values when one looked from the work to the luminaire, from window to chalkboard, etc. On the basis of a study of eye motions under various conditions, a suitable set of eye motions could be chosen as adequately characterizing the particular application. Then the range of values of VCI could be given for the important sequences of eye motions. Information on whether a given luminous environment would be comfortable for work, for conversation, or for relaxation could then be given. Discomfort arising from bright luminaires, unshaded windows, dark furniture, or specular reflections would all be included in a single analysis.

(c) *Range of Data.* If a visual-comfort index scheme is to be accepted by the Society, the index must be based on

*University of Connecticut, Storrs, Conn.

adequate experimental data covering the entire range of terrestrial visual conditions from starlight to sunlight. While Dr. Guth's data are superior to those of his British and Dutch contemporaries in this respect, they are still entirely inadequate. To cover a suitable range, Dr. Guth's values of "surround brightness" should be extended upward by a factor of 10 or better 100. The largest solid angle for which even meager data have been obtained with a few observers is 0.13 steradians. However, luminous ceilings and natural skies often subtend solid angles well in excess of one steradian. Data for these important situations should be available.

In his introductory discussion of Report No. 1 of the S.Q.Q. Committee, Dr. Guth erroneously states that it was "based largely upon the experiments of Holladay." Though it is easy to see how Dr. Guth drew this conclusion from the excessively abbreviated form of the published report, he would have had quite a different understanding of the situation if he had been a member of the original Committee. The report contained two parts. Only one of these was based on the comfort experiments of Holladay. Many of us did not wish to see this part included at the time as the experimental basis was entirely inadequate. Fortunately this part of the report has been largely forgotten.

The important part of the report is the 3:1 adaptation helios criterion. True, this is stated in the report in a form which is subject to misinterpretation. But if properly stated and properly interpreted, it forms the most useful criterion we have for quality in lighting.

The experimental basis for the choice of a 3:1 ratio was very broad. Mr. Ainsworth found this criterion satisfied in the delightful outdoor conditions which he observed in his favorite lighting laboratory — a green field bordered by trees on his Long Island farm — viewed a few minutes before sunset when about 50 lumen ft^{-2} were incident on the work. Mr. Logan's measurements of the flux distribution in pleasant natural surrounds in New York State and in Mexico (when converted from zonal flux to helios) also gave support to the choice of a 3:1 adaptation helios ratio. In addition, the work of Dr. Luckiesh on the correlation of physiological responses (such as blink rate, finger pressure, etc.) with the luminous environment indicated little change until the 3:1 criterion was exceeded.

Finally the summary of all available experimental data on visual performance in uniform and non-uniform surrounds which Professor Moon and I had just completed indicated that, at the adaptation levels most important in illuminating engineering, a change of 3:1 in the adaptation helios would change minimum perceptible size of high-contrast detail by only 3:1. As we normally work in the suprathreshold region, such small changes would not ordinarily be perceptible. In such an environment, the eyes could wander over the entire field of view without major changes in the state of adaptation. At all times visual performance would be close to optimum.

The 3:1 criterion has a two-fold distinction. It is the simplest criterion for quality in lighting that has been proposed yet it is also based on the largest body of experimental evidence. In the ten years since it was first proposed the 3:1 criterion has been demonstrated to be both practical and satisfactory. It is easy to apply for all lines of sight at the design level by the interflection tables, easy to check in the completed building with a photoelectric helios meter or with the Luckiesh-Taylor brightness meter. The excellent results in such lighting designs lend further support to the criterion. Thus, after ten years, the most important criterion for quality in lighting is still the 3:1 adaptation helios criterion.

H. Richard Blackwell:* I find Mr. Kalff's comments on my paper amusing, although I find myself in vigorous disagreement with his counsel regarding the problem of specifying interior illumination. Mr. Kalff would have us revert to the intuitive approach, wherein some illuminating engineers have the *art* and others, regrettably, do not have it. There is, of course, no positive way to tell whether or not a particular engineer has *the art;* we must let all engineers try their hand at it, and sample the product to evaluate the level of their *art*. We cannot be certain that *the art* will transfer from one assignment to another. After all, a good soup cook may be less than satisfactory with crepes suzette. Nor can we be assured that any man not now living will be able to take over the mantle of our great living artists, since *the art* is entirely intuitive and who can expect to explain the inexplicable? I suggest that Mr. Kalff stick to art and we to science.

S. K. Guth:** Mr. Kalff is extremely fortunate that he has a good cook at home, but I wonder what his reactions would be if he had to employ a novice whose only experience consisted of watching the expert once. If a recipe for soup merely read, "combine some water, vegetables, seasoning, cook and serve" without any indication of quantities, I'm sure he would be extremely unhappy with the result. Relatively few people are creative and even they must record their recipes so they can be duplicated by themselves as well as others. This is what we are trying to do for lighting practice. We want to make sure that neither too little nor too much salt is added to the broth. Mr. Kalff, on the other hand, is thinking more in terms of the herbs which make a particular recipe especially delectable.

Mr. Kalff's dissatisfaction probably arises from what he considers a lack of emphasis on aesthetic aspects of light and lighting. As an artist, he naturally feels that the exclusion of decoration, color and other pleasureable factors is a sin of omission. The purpose of my paper was to review the status of our knowledge regarding discomfort produced by sources of brightness. Reverting again to soup, it was concerned with the relative proportions of the necessary ingredients to provide a useful and nourishing recipe. Once these have been determined, artists like Mr. Kalff will be in an excellent position to add the exotic seasonings which will make it even more pleasing and delectable.

With regard to Mr. Logan's comment, transitional zones, brightness patterns, etc., in a visual environment were outside the scope of the paper, as was his "flux system of evaluation." However, I would deprecate the use of the word "glare" to describe sparkle and glitter incorporated in the artistic design of a room. Our calling it glare or sparkle depends upon whether the object is a slide rule or silverware.

I agree with Mr. Logan that it would be desirable to consider the uniqueness of the individual. But unfortunately we all can't occupy private cubicles. Lighting and all environmental factors must be designed for group satisfaction. Thus, we find it necessary to study the reactions of large numbers of people to determine what has a good chance of being desirable. Even his flux system of evalua-

*Author, "Use of Performance Data to Specify Quantity and Quality of Illumination."
**Author, "Quality of Lighting."

tion is based upon a statistical consideration of man. By using a visual comfort rating in the brightness limitation studies we do take into consideration individual differences. We have a two-fold obligation: to be neither too restrictive nor too lenient in the requirements of luminaire brightnesses, and to develop knowledge regarding what must be done to compensate if all factors are not readily controllable.

A perennial question is the one involving experienced vs. lay observers. Most of us have encountered complaints voiced by the latter, generally to the effect that there was "too much light." Their comments often are similar to those of a person trying to describe the location of a squeak in an automobile. The trouble is seldom located where it seems to be. The average person is a poor diagnostician. Furthermore, many seem to think that discomfort is a necessary evil accompanying high lighting levels, or improved visibility outweighs the importance of comfort. Our experience — and that of others — indicates that the Harrison-Meaker and Guth methods as currently used give results consistent with subjective evaluations. As was pointed out in the paper, there is still much information to be obtained before we will be able to develop a universally satisfactory method for evaluating discomfort.

No one need be concerned by our overlooking the broader aspects of the design of interiors. Our lighting literature contains much on the subject. Artists and decorators are active and helpful to insure that we do include their very welcome viewpoint.

I agree with Dr. Spencer that it would be very nice indeed if we could have a precise definition of comfort. Yet, its meaning is not quite as vague as she infers. People generally are quite definite when they express themselves regarding the comfort or discomfort of a given situation. It is true that it cannot be evaluated as precisely as physically measurable things, but this should not deter us from studying it. Interestingly enough, while she seems to deplore visual comfort studies, Dr. Spencer refers to the subjective evaluation made by Messrs. Ainsworth and Logan to support the 3:1 brightness ratio. Both of them used "pleasant" and "attractive" lines of sight, generally in a horizontal direction.

Perhaps we should refer to the absence of discomfort rather than to the presence of comfort. This was discussed at some length at the recent C.I.E. meeting in Zurich. Regardless of how it is stated, it should be obvious that we mean the former. However, the visual comfort index (VCI) was developed as a result of a popular demand for a positive rather than a negative numerical rating. The users of light and the members of our Society are not interested in discomfort, but in learning how to avoid it.

While it is true that momentary exposure of sources was used in the BCD investigations, Dr. Spencer has lost sight of the fact that most of the studies involved *comparative evaluations*. For example, observers are required to judge whether a given brightness is more, equally or less comfortable than another. The technique employed permits doing this on a quantitative basis with a high reliability. In other words, we do not evaluate a flashing environment *per se* but relate complicated brightness conditions to a simple one that can be handled mathematically.

Data are available which will enable one to evaluate any line of sight. It is merely necessary to take into account correspondingly different position or brightness weighting factors. It has been found that the horizontal line of sight is sufficiently representative for comparative purposes. It does not involve the extreme of looking directly at a source nor complete shielding by a head down position. Obviously, if other lines of sight are important, they should be considered. However, it seems that we cannot help but choose the middle of the opposite wall because that is the only spot for which Moon and Spencer interflection data give brightness. In other words, it often is necessary to make a logical assumption to reach a solution to a problem.

It has been emphasized many times by many people that our primary concern is with interior lighting problems. It seems of only academic interest to be able to evaluate the comfort of starlight and sunlight situations outdoors. We have no control over either. Why should we complicate our lighting techniques in order to determine whether or not Nature has done a good job? On the other hand, we do need additional data covering somewhat larger luminous areas so as to eliminate extrapolation of existing relationships. About one steradian seems to be a reasonable limit since it encompasses the visible ceiling areas in even large rooms for normal lines of sight.

While that part of S.Q.Q. Report No. 1 dealing with luminaire brightnesses may have been forgotten, the need for such information is still with us. As was pointed out in the paper, the brightness-ratio method has been found satisfactory when dealing with the visual task and its immediate surround. But the ratios do not take into consideration the interrelated effects of size, brightness and location of sources nor how changes in one may be compensated by changes in the others. These factors must be included in order to obtain an adequate appraisal of the relative comfort of a lighting system. It seems very necessary to use something more than Dr. Spencer's adaptation helios which falls far short when we are concerned with visual comfort and discomfort indoors.

The analyses that Dr. Spencer and Professor Moon have made of visual performance data are in terms of what we commonly term disability glare. That is, they dealt with the effects of directly viewed sources of brightness upon visual acuity and contrast sensitivity. This has nothing to do with comfort-discomfort evaluations and is outside the scope of the paper and this discussion. Suffice it to say that there have been many visually uncomfortable situations in which there was no measurable loss in visual performance. Furthermore none of the comfort studies used as the bases for the 3:1 ratio involved tests with sources of brightness corresponding to luminaires but dealt only with the brightness of the immediate surrounding field. Thus, as stated in Report No. 1, the ratios pertain to adjacent and not remotely located areas.

The 3:1 brightness ratio criterion may be suitable for evaluating luminous ceilings which provide moderate levels of illumination. But I should like to remind Dr. Spencer that such things as luminaires are being used for lighting and such a ratio can be unduly restrictive. I am sure that Mr. Kalff finds it so. On the other hand, we do not want to be too broad in our specification of brightness limitations. Practical experience has indicated that brightness ratios are variable and that adherence to a single ratio for all lighting systems and various levels of illumination is not justified.

INSTALLATION AT NELSON'S FURNITURE, 6501 ROOSEVELT BOULEVARD, PHILADELPHIA, PA.

Lighting a Furniture Store

LIGHTING OBJECTIVE: To provide general and supplementary lighting in the first floor sales area of a retail furniture store.

GENERAL INFORMATION: Fig. 2 is a plan view of the furniture store shown above; ceiling height is 11 feet 4 inches. Colors and reflectances are as follows:

ceiling	white	85% RF
walls	light pastel green	60% RF
floor	mottled gray with a small percentage of white	30% RF
columns	light pastel green	60% RF

INSTALLATION: General illumination in the main sales area is provided by thirty-six Silvray "Sky-like" catalog No. RP 50F/300 luminaires with egg-crate louvers, each using a 300-watt PS-35 inside frosted silvered bowl lamp. Accent lighting on the rug display is provided by four Swivelier catalog No. B-81 canopy shade units and four Swivelier catalog No. 725 Gyro-lite units each using a 150-watt R-40 reflector spot lamp. Additional localized and window lighting is provided by Kirlin catalog No. 1208L downlights and Pittsburgh Reflector catalog No. 85 window reflector units as shown in Fig. 2. The general illumination after 500 burning hours was as follows:

Silvray luminaires only	21 ft-c
Silvray and Swivelier luminaires	27 ft-c

(over)

A.I.A. File No. 31-f

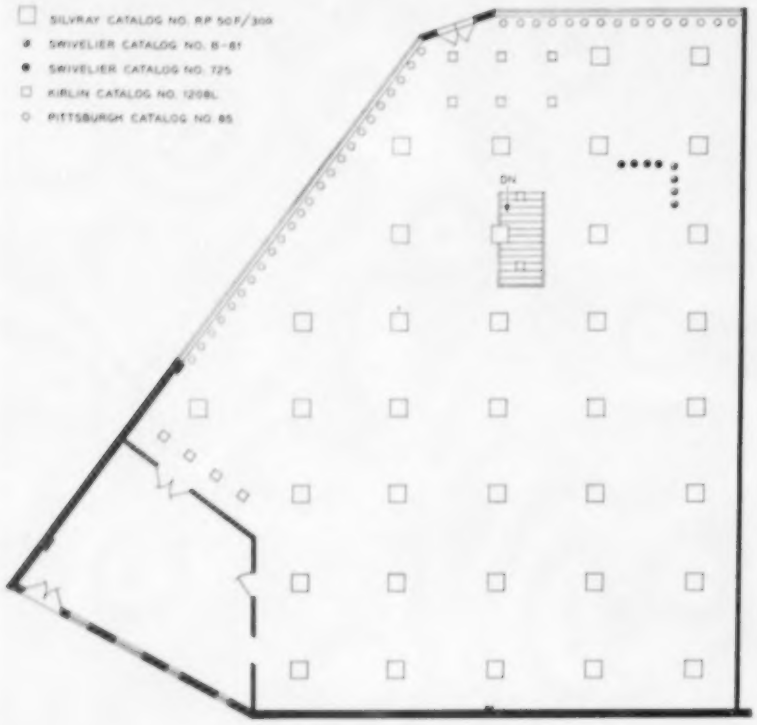


Figure 2. Plan view showing location of lighting equipment.

Brightness distribution is indicated below:

Silvray luminaires	
at 45°	1900 ft-L
at 40°	1550 ft-L
at 30°	815 ft-L
at 20°	665 ft-L
ceiling (between luminaires)	7.6 ft-L
walls	12.8 ft-L
floor	9 ft-L

Lighting designed by George T. Anderson, Jr., Lighting Engineer, Philadelphia Electric Co.

Lighting data submitted by George T. Anderson, Jr., Philadelphia Electric Co., 1015 Chestnut Street, Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Questions and Answers on light sources

The I.E.S. Committee on Light Sources, under the chairmanship of H. F. Davidson, has prepared this discussion to answer a question on dimming fluorescent lamps. Readers are invited to submit similar questions of general interest to be considered for publication. Questions should be sent in care of Society Headquarters office.

Dimming of Fluorescent Lamps

There are many applications where it is desirable to control the illumination provided by artificial lighting systems over a considerable range. These applications include auditoriums, conference rooms, dining and entertainment areas, churches, stages, signs and spectacular displays, to mention only a few. Until recent years only filament lamps and series-operated cold-cathode fluorescent lamps were practical light sources for dimming installations. Many experimental circuits were tried for varying the brightness of standard hot-cathode fluorescent lamps, but the successful ones were too complex and expensive for general use. The purpose of this article is to review the present status of different dimming systems for hot- and cold-cathode fluorescent lamps.

Hot-Cathode Lamps—Two general types of systems are now commercially available: (1) Electronic dimming control and (2) adjustable auto-transformer dimming control. Both take advantage of the low power loss required to maintain electron emission from the rapid-start 40-watt T-12 lamp.

The Electronic dimmer was introduced in 1952 and uses the circuit shown in Fig. 1. The amount of lamp current and the portion of the cycle that the current flows is regulated by two thyratron tubes. The brightness selector is a small potentiometer which controls the phase of the voltage applied to the thyratron grids (Fig. 2). At the same time, sufficient voltage is maintained across the lamps to insure reliable starting, and re-ignition of the lamp discharge each half cycle. The elements in the Selector can be arranged to accomplish a variety of dimming results, such as

(1) A simple knob rotation.
(2) Push-button controls for pre-set illumination levels.
(3) Electrical or mechanical gauging to operate several dimming units from a single control.
(4) Multiple station control.
(5) Motorized or photocell control.

The electronic dimmer unit provides 100-to-1 brightness control, and gives good lamp starting at any point in the brightness range. At the present time two models are available: One controls up to 35 lamps, the other up to 8 lamps. Both models are 7½" wide and 14" long, with the 8-lamp unit 8" high and the 35-lamp model 11" high. They differ principally in the size of the thyratron tubes employed. A single-lamp ballast is used for each lamp, with the fixture wiring similar to that of rapid-start circuits. The ballasts are 1⅛" by 2⅜" by 10" in size. At present electronic dimming units are available for only 228-250-volt primaries. Small step-up transformers can be used for 120-volt systems — 1.5 kva for the 8-lamp unit and 5.5 kva for the 25-lamp unit. More recently at least two types of "simplified" dimming controls have appeared. Both use modified single-lamp 40-watt rapid-start ballasts and an autotransformer type of control, in one case to secure adjustable reactance, and in the other design to vary the voltage impressed across the lamp. These simplified circuits

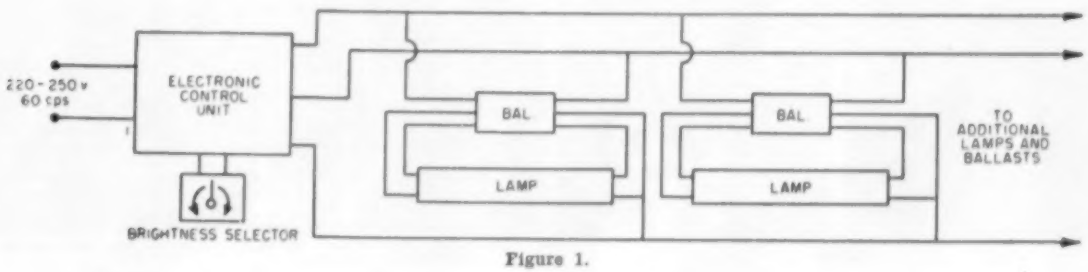


Figure 1.

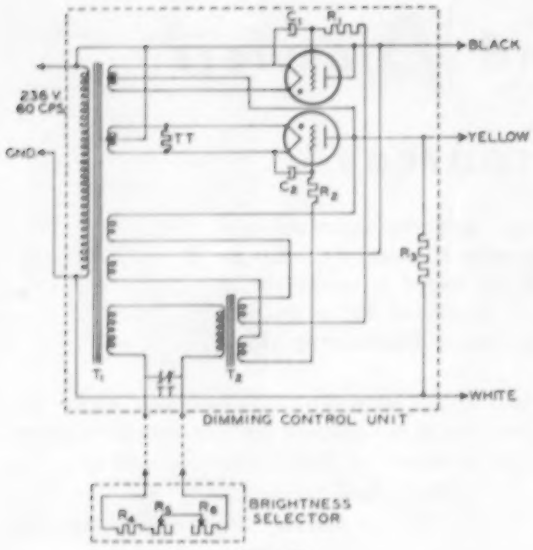


Figure 2.

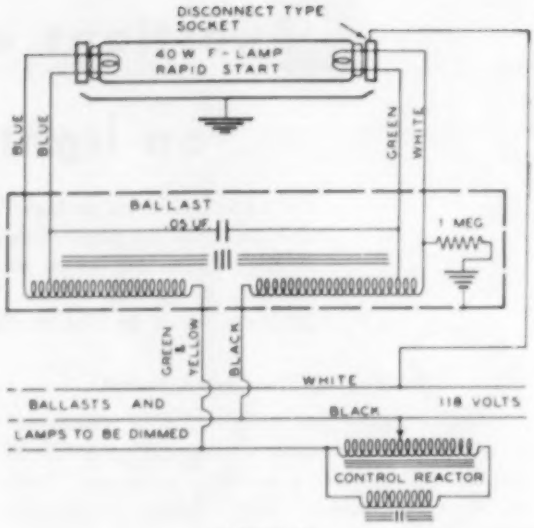


Figure 3.

involve no electronic tubes with attendant warm-up time and will provide satisfactory dimming for many applications where the additional flexibility and brightness range of the thyratron unit is not needed.

Fig. 3 shows the wiring connections for the adjustable reactance design of simplified dimming control which allows a 25-to-1 brightness range. Two of the three connecting wires carry the 120-volt power and the third wire runs from the control unit to the dimming ballasts. The latter are $1\frac{1}{4}$" by $2\frac{3}{8}$" in cross section, and available in an uncorrected power factor model $6\frac{1}{2}$" long and a high power factor unit 10" long. The adjustable reactance device for handling up to 8 lamps is 4" deep, 8" high and 7" wide.

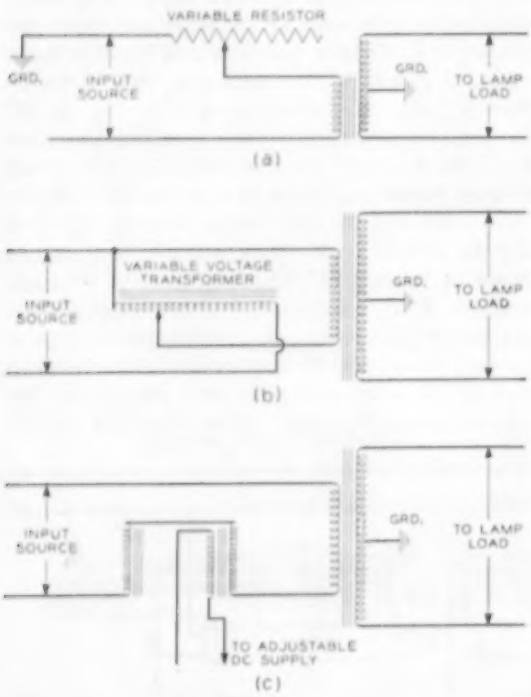


Figure 4.

Cold-Cathode Lamps — Dimming of cold-cathode lamps down to about 10 per cent of maximum brightness can be accomplished by varying the primary voltage applied to the primary of high-voltage transformers designed for series operation of such lamps. To secure freedom from flicker at low input voltages, it is suggested that the footage of cold-cathode lamps be reduced 15-20 per cent below that recommended for normal operation by the transformer manufacturer.

Three methods can be used to vary the voltage delivered to the primary winding. Rheostats are relatively inexpensive and suitable for small installation, but the wattage consumption of the circuit is practically constant over the entire brightness range. Adjustable voltage transformers have been more widely used with comparatively low wattage loss in the control device. Saturable reactors of the type long used to dim incandescent lamps in theatrical applications can also be used for series cold-cathode systems. All three types of dimming controls are shown in Fig. 4.

1. Campbell, J. H., Schultz, H. E., Abbott, W. H.: "Dimming Hot-Cathode Fluorescent Lamps," ILLUMINATING ENGINEERING, January 1954.
2. Miller, E. A.: "Transformers and Ballasts for Cold-Cathode Lighting Installations," ILLUMINATING ENGINEERING, September 1945.
3. Carpenter, W. P.: "Application Data for Proper Dimming of Cold Cathode Fluorescent Tubing," ILLUMINATING ENGINEERING, June 1951, pages 306-309.

I. E. S. Council – 1955-1956

The Council of the Illuminating Engineering Society is comprised of the President, Senior and Junior Vice-Presidents, Treasurer, General Secretary, two Past Presidents, six Directors, and the ten Regional Vice-Presidents, whose photographs appear on the following pages, each with the Section/Chapter Chairmen in his Region.

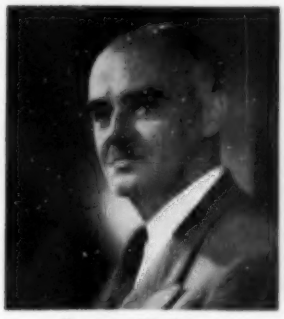
Robert F. Hartenstein
President

M. N. Waterman
Vice-President

Kirk M. Reid
Vice-President

George J. Taylor
General Secretary

J. S. Schuchert
Treasurer



Duncan M. Jones
Past President

A. H. Manwaring
Past President

Brooks Chassaing
Director

G. F. Dean
Director

C. C. Shotwell
Director

W. A. Stannard
Director

L. C. Twichell
Director

J. S. Walsh
Director

CANADIAN REGION

Joseph Thomas
Regional Vice-President
and Member of the I.E.S. Council

Henry Lushington
Chairman, Bluenose
Chapter

Chester Kuzniar
Chairman, Hamilton
Ontario Chapter

A. G. V. Smith
Chairman, Montreal
Section

George Hopkinson
Chairman, Quebec
Chapter

K. R. Dunphy
Chairman, Toronto
Section

A. McDowell
Chairman, Winnipeg
Chapter

(Photographs of Maritime Chapter and Ottawa Chapter Chairmen not available in time for publication.)

EAST CENTRAL REGION

Nelson C. Warner, Regional Vice-President
and Member of the I.E.S. Council

Benjamin Goodman
Chairman, Capital
Section

Ford M. Gochenaur
Chairman, Eastern
Pennsylvania Section

G. William Wagner
Chairman, Philadelphia
Section

Hugh S. James
Chairman, Pittsburgh
Section

Lynn W. Ferguson
Chairman, Virginia
Chapter

(Photograph of the Maryland Section Chairman not available in time for publication.)

GREAT LAKES REGION

A. C. Sangster, Regional Vice-President and Member of the I.E.S. Council

William McNulty
Chairman, Central New York Section

George K. Warner
Chairman, Cleveland Section

R. P. Kniesz
Chairman, Miami Valley Chapter

Edward L. Fairchild
Chairman, Michigan Section

A. P. Hammerstrom
Chairman, Northwestern Ohio Section

Beattie M. DeLong
Chairman, Ohio Valley Section

William S. Barclay
Chairman, Rochester Section

L. G. Thompson
Chairman, Western Michigan Section

W.E. Hayes
Chairman, Western New York Section

INTER-MOUNTAIN REGION

J. D. Whitnell, Regional Vice-President and Member of the I.E.S. Council

Bevan Jones, Jr.
Chairman, Arizona Section

William B. Hills
Chairman, New Mexico Chapter

Glenn B. Gaer
Chairman, Rocky Mountain Section

Sigurd A. Blomquist
Chairman, Utah Section

(Photograph of the Southern Colorado Chapter Chairman not available in time for publication.)

NORTHEASTERN REGION

C. W. McCormick, Regional Vice-President and Member of the I.E.S. Council

Arthur E. Peabody
Chairman, Eastern New York Section

William B. Elmer
Chairman, New England Section

Louis Goren
Chairman, New York Section

(Photograph of the Connecticut Section Chairman not available in time for publication.)

MIDWESTERN REGION

J. R. Chambers, Regional Vice-President and Member of the I.E.S. Council

James W. Brown
Chairman, Central Illinois Chapter

R. J. Diefenthaler
Chairman, Chicago Section

C. P. Haas
Chairman, Cornhusker Chapter

Carl W. Thorsell
Chairman, Heart of America Section

Edward M. Chelew
Chairman, Ottawa Section

LeRoy J. Widigen
Chairman, Iowa Section

Beverly R. Bunn
Chairman, Milwaukee Section

E. W. Stohlmann, Jr.
Chairman, St. Louis Section

Cecil H. Branham
Chairman, Twin City Section

R. G. Rockwood
Chairman, Twin Ports Chapter

PACIFIC NORTHWEST REGION

Blair Plowman, Regional Vice-President and Member of the I.E.S. Council

J. H. Gilbreath Chairman, British Columbia Section

Joseph M. Doyle Chairman, Inland Empire Chapter

Donald Edmundson Chairman, Oregon Section

G. Donald King Chairman, Puget Sound Section

A. C. F. Evans Chairman, Vancouver Island Chapter

SOUTH PACIFIC COAST REGION

Dan M. Finch, Regional Vice-President and Member of the I.E.S. Council

Harold A. Wright Chairman, Golden Gate Section

William Ross Chairman, Mother Lode Chapter

Roy H. Kreyser Chairman, Southern California Section

(Photographs of the San Diego Chapter and San Jose Chapter Chairmen not available in time for publication.)

SOUTHERN REGION

J. D. Mitchell, Regional Vice-President and Member of the I.E.S. Council

E. B. Richey
Chairman, Alabama Chapter

Paul F. Cratin
Chairman, Arkansas Chapter

J. A. Savarese, Jr.
Chairman, Florida Section

Judd Lough
Chairman, Georgia Section

H. Sidney Chilton
Chairman, Mid-South Chapter

L. H. Hickman
Chairman
Mississippi Chapter

J. M. Gensburger
Chairman, New Orleans Section

Glenn M. Rice
Chairman, Palmetto Chapter

James A. Foerster
Chairman, Southeast Florida Chapter

W. H. Sadler
Chairman, Suwannee River Chapter

Coy C. Jordan
Chairman, Tar-Heel Section

C. H. Patterson
Chairman, Tennessee Valley Section

SOUTHWESTERN REGION

John G. Felton
Regional Vice-President
and Member of the I.E.S. Council

D. V. Hileman
Chairman, Alamo Chapter

C. R. Shepherd
Chairman
Ark-La-Tex Chapter

Paul R. Sheline
Chairman, Central Oklahoma Chapter

Ray H. Bowyer
Chairman, Oil Capitol Section

Edward C. Ober
Chairman, San Jacinto Section

J. E. Metzenthin
Chairman
Southwestern Section

1956 Regional Conferences

April 5-7	Southern Region	Birmingham, Alabama
April 8-10	Southwestern Region	Fort Worth, Texas Hilton Hotel
April 15-17	South Pacific Coast Region	San Francisco, California
April 19-21	Pacific Northwest Region	Spokane, Washington Davenport Hotel
April 26-28	Inter-Mountain Region	Salt Lake City, Utah Utah Hotel
May 7-8	Great Lakes Region	Toledo, Ohio
May 10-11	Midwestern Region	Indianapolis, Indiana
May 17-18	Canadian Region	Quebec, Quebec Chateau Frontenac
May 24-25	East Central Region	Washington, D. C. Shoreham Hotel

T E L E C A S T

LIGHTING NEWS OF CURRENT INTEREST

Education and Promotion Awards Announced for Utility Companies

Two new awards, for educational activities and sales promotion programs of public utility companies, have been announced as outgrowths of the Planned Lighting Awards which have been discontinued.

The Lighting Promotion Awards for electric lighting sales promotion activities are being administered by the Prize Awards Committee of the Edison Electric Institute and are sponsored by the Lamp Divisions of the General Electric Co., Sylvania Electric Products, Inc., and Westinghouse Electric Corp.

Purpose of the awards is to recognize outstanding lighting sales promotional activties in the following divisions: the Residential Lighting Division and Commercial-Industrial Lighting. Entries in the latter division may cover commercial or industrial or a combination. All operating electric light and power companies in the United States, its possessions and Canada are eligible to enter. Activities conducted during the twelve-month period ending December 31, 1955 are eligible for inclusion.

Factors to be considered by the judges are: organization and methods, advertising and promotional activity, cooperative activities with allied industry, either direct or through electric leagues and associations, and the results. Further information can be secured from the Secretary of the Prize Awards Committee of EEI.

The Educational Activity Award is being sponsored by the Better Light Better Sight Bureau, with the intent of giving recognition to noteworthy educational activities which foster a better understanding of the relationship of light and sight.

Two bronze plaques will be presented, one for companies with 250,000 or more total meters, and one for the under 250,000 group. The award will be known as the Better Light Better Sight Award for Lighting Education, and will also cover activities conducted during the year 1955.

Both the education and sales promotion awards will be made at the next Sales Conference of the Edison Electric Institute.

Industrial Health Is Subject For Two-Day Meeting

Representatives of industrial management and the health professions will get together on possible solutions to industrial health problems at the 20th Annual Meeting of Industrial Hygiene Foundation, to be held at the Mellon Institute, Pittsburgh, Pa., November 16-17.

The technical sessions will deal with the medical, legal, engineering, chemical and toxicological phases of occupational health, with the specific aspects being covered by panel discussions and informal question and answer periods. The engineering session will endeavor to bring to the attention of plant engineers new developments and ideas on engineering measures which have effects on the working environment.

Report on National Technical Conference To Be in November IE

The complete report on the I.E.S. National Technical Conference, with photographs of the major events, awards, and other highlights of the Cleveland meeting, will be featured in the November issue of IE, Telecast Section.

SMPTE Studies Color TV And Motion Picture Lighting

Color in motion pictures and television is the theme of the 78th convention of the Society of Motion Picture and Television Engineers, which was held at the Lake Placid Club, Essex County, N. Y., October 3-7. Lighting problems and developments formed a part of the discussion at several of the technical sessions, on studio practice, projection and viewing, laboratory practice, and high-speed photography. The control of the spectral quality of television studio lighting as a means of producing accurate color rendition in the television picture was covered by Rollo Gillespie Williams of Century Lighting.

Another activity of SMPTE is its educational program currently consisting of three courses of instruction for film industry technicians, in cooperation with the University of California. The courses, which began last month in Los Angeles, represent the initial efforts of the organization's Committee on Education to meet the need for trained technical personnel in the motion picture industry.

The courses—of 18 weekly seminars—are on "Illumination Optics," "Motion Picture Laboratory Practice," and "Duplication of Color Motion Pictures." They are the result of cooperative efforts of representatives of universities, motion picture studios and laboratories, and labor unions, to bring instruction in technology to members of the industry.

The course in Illumination Optics is being conducted by Ernest W. Silvertooth, Engineer, Librascope, Inc.; that in Motion Picture Laboratory Practice by four instructors from major laboratories in the Hollywood area; and that in Duplication of Color Motion Pictures by Roderick T. Ryan, Eastman Kodak Co. All three courses are under the direction of Dr. John G. Frayne of Westrex Corp., SMPTE President and Chairman of the Education Committee; and Sidney P. Solow, Consolidated Film Industries, Chairman of the Subcommittee on Training of Film Laboratory Technicians.

F. Edwin Blair, Dan Finch and Roy Kreyser

Southern California Section Inaugurates New Year

Installation of officers for the coming year, 1955-1956, was one highlight of the September 7 meeting of the I.E.S. Southern California Section, in Los Angeles. Attendance was 103. In photo above, F. Edwin Blair, retiring Section Chairman, hands over the gavel to incoming Chairman Roy Kreyser. Regional V-P Dan Finch looks on.

In the photo below, the officers and committee chairmen are shown at the same meeting. Left to right are, seated: Roy Kreyser, Chairman; Dan Finch, Regional V-P; George Hochenauer, Vice-Chairman, Merle Potter, Secretary-Treasurer; Dr. Henry Knoll and Del Reynolds, Board of Managers. Standing, first row: Sydney Meyerson, Frank Tharp, Benn Hartmann, William Friend (rear), Don Prideaux, J. M. Russell, John Losh (rear) Hugh Sheeter, Jerry Silvers, Henry Klopot, Clayton Gibbs (rear) Bruce Campbell. Standing, back row: Audie Ashcraft, Roy Bevan, John Kresich, Don Rowanoff, Fred Cooper, David Cook, Ted Shepherd and Leonard Hobbs. Missing from photo are Edwin Blair and Glen Gagadorn, Board of Managers and 13 committee chairmen. Note large badges worn by officers and chairmen.

Southern California Section Officers and Committee Chairmen

I.E.S. Gold Medal Nominations Have January 1 Deadline

January 1 is the closing date for receipt of nominations for the I.E.S. Gold Medal. Nominations for this, the highest award of the Society, are invited from all members to be considered by the Medal Award Committee.

The I.E.S. Gold Medal is awarded to give recognition to meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering. The following points should be observed in making nominations for the Award.

(1) Candidates need not be members of the Society, nor citizens of the United States or Canada. Nominations may be made at any time by any member of the Society by presenting to the General Secretary, care of Society Headquarters, the name of the individual whose accomplishments are deemed worthy of such recognition — in the field of engineering, design, applied illumination, optics, ophthalmology, lighting research, education, or administration and management.

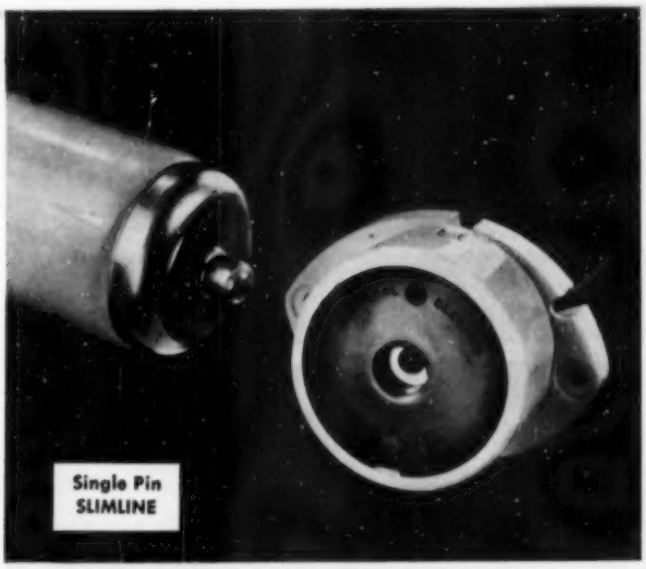
(2) In order for a candidate to be considered for the award of a given year, a letter requesting such consideration shall be delivered at the General Office of the Society before January 1 of that year.

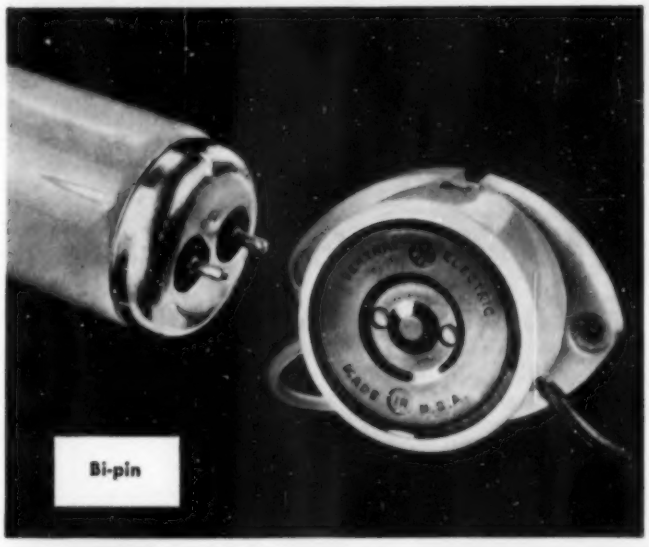
(3) Nominations and records on file from previous years, as reviewed and referred to the incoming Committee by the previous Medal Award Committee will be given consideration along with new nominations.

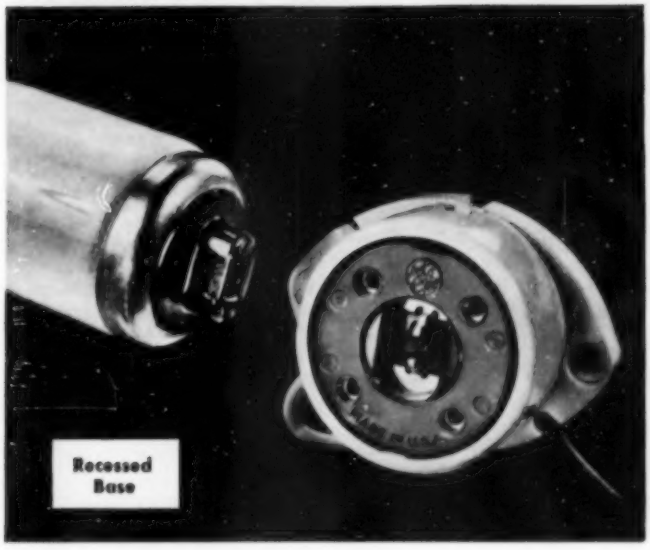
Certified Lighting Program Analyzes Questionnaire Response

Results are being analyzed of the response to a questionnaire sent out by the Electrical League of Rhode Island, which sponsored the Certified Lighting Program in that area beginning in Providence last Autumn on a test-city basis. Since that time, it is reported that 89 per cent of the city contractors responding said they had been able to sell better quality lighting installations, with 35 per cent adding that they had been able to increase the size of their contracts as a result of selling methods suggested in the course. More prospects in relighting were reported by 65 per cent, and 57 per cent said they had learned to close sales more easily. The training program consisted of eight two-hour evening meetings, divided between sales training and technical instruction on

(Continued on page 9A)







G-E announces new family of compressible holders

FOR ALL FLUORESCENT LAMPS

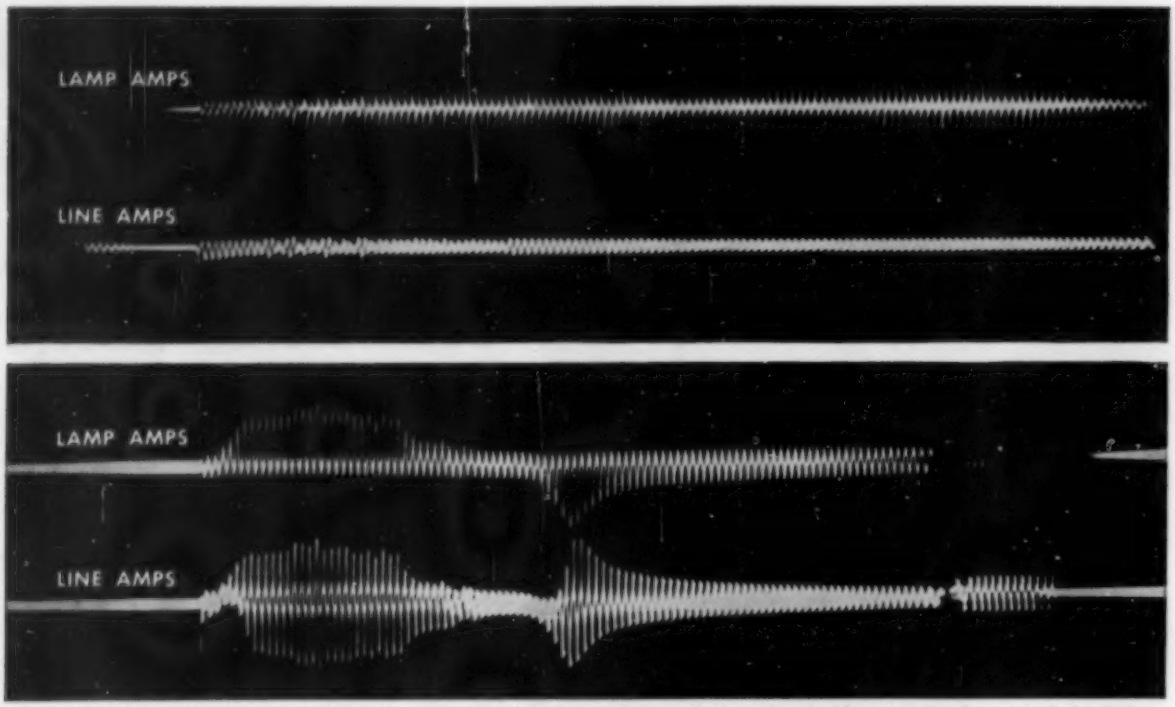
Dark area sharply reduced by minimum back-to-back dimensions

These new G-E ear mount holders completely eliminate danger of falling lamps . . . single pin Slimline, bi-pin, or recessed base . . . they all stay put without safety guards. No twisting or positioning needed. You snap lamps in or out instantly.

Every member of this new family of G-E lampholders is ear-mounted . . . compressible . . . and has identical physical and minimum back-to-back dimensions providing interchangeability. The exceptionally shallow design cuts down dark area substantially. Either vertical or horizontal lamp contact position may be had for bi-pin or recessed end lamps without change in mounting location. This family of lampholders has been approved for use in outdoor signs. For complete information on these new lampholders, write Accessory Equipment Department, General Electric Company, Bridgeport 2, Connecticut.

Progress Is Our Most Important Product

GENERAL ELECTRIC



COMPARISON OF STARTING CHARACTERISTICS for regulated and unregulated mercury vapor lamp ballasts shows (above) 400w E-H1 mercury vapor lamp with Sola Ballast Cat. No. 77034 and (below) the same lamp with conventional non-regulating ballast. Comparison illustrates Sola's current-limiting characteristic, an advantage of its constant wattage circuit.

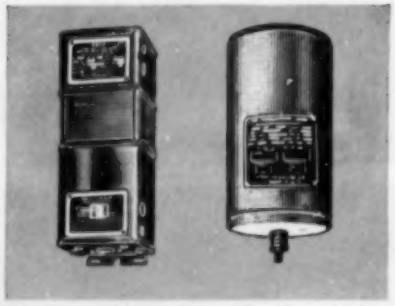
Sola Constant Wattage Mercury Vapor Ballasts Limit Starting Surge, Extend System Capacity

In addition to regulated lumen output, the Sola Constant Wattage Circuit also yields other important advantages. Starting characteristics are an important example. Sola Constant Wattage Mercury Vapor Lamp Transformers limit line current surge at the instant of starting to effectively no more than normal full load value. This eliminates the need for time-delay relays, oversize circuit breakers, and heavier wiring required by the starting characteristics of conventional, non-regulating transformers.

In addition, premium performance Sola Constant Wattage Transformers provide six other specific advantages:

- Stabilized light output within ±2½% with line variations as great as ±13%.
- Lamps stay lit, even when line voltage drops as much as 40v (on a 115v line).
- Positive starting within the primary ranges of 100-130 x 200-260v.
- Elimination of primary taps.
- Primary current limited on both open and short circuit.
- More ballasts can be installed per circuit.

For further information, call your Sola representative.



Sola Mercury Vapor Lamp Transformers, employing the patented constant wattage circuit, are available for indoor (left) and outdoor (right) industrial and commercial applications. The moderate differential in original cost, over non-regulating ballasts, is often eliminated by installation savings and by continuous high quality performance.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**

Write for Bulletin 3JMV-211 for indoor applications, and Bulletin 3JMV-219 for outdoor applications.

CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO.**, 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414 • *NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464 • PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988 • BOSTON: 272 Centre Street, Newton 58, Mass., Bigelow 4-3354 • CLEVELAND 13: 1836 Euclid Ave., PRospect 1-6400 • KANSAS CITY 2, MO.: 406 W. 34th St., Jefferson 4382 • LOS ANGELES 23: 3138 E. Olympic Blvd., ANgelus 9-9431 • TORONTO 9, ONTARIO: 617 Runnymede Rd., RO 7-1654 • Representatives in Other Principal Cities*

(Continued from page 6A)

lighting layouts. Concurrent with, and following the instruction, a campaign of radio, newspaper and direct mail advertising has been carried on in the area of the Rhode Island Lighting Bureau.

The plan is now in operation in eleven areas of the United States:

Rhode Island — sponsored by the Electrical League of R. I.
Eastern Massachusetts — sponsored by the Electric Institute, Inc.
Indianapolis — sponsored by the Electric League of Indianapolis.
San Diego County — sponsored by the Electrical Contractors of San Diego County, Calif.
Northern California — sponsored by the Northern California Electrical Bureau.
Charlotte, N. C. and Surrounding Area — sponsored by a committee of leaders of various parts of the lighting industry.
Southwestern Ohio — sponsored by the Cincinnati Electrical Association.
Fort Worth, Tex. — sponsored by the Fort Worth Electric Club.
Middle Eastern Michigan — sponsored by the Electrical Association of Detroit.
Chattanooga — sponsored by the Electric League of Chattanooga.
Worcester, Mass. — sponsored by the Worcester County Electrical League.

Canadians also are studying the program. A committee of the Canadian Electrical Manufacturers Association has requested information about it and is studying its details for possible launching in Canada.

Electrical Industries Show Keyed to Adequate Wiring Theme

The Third National Electrical Industries Show, sponsored by the Eastern Electrical Wholesalers Association, October 11-14, is built around the theme of "Safety Through Adequate Wiring," with a large proportion of the show's exhibits stressing the built-in safety features of their products for the home and business.

The show is being held at the 69th Regiment Armory, New York City.

Airport Beacon Developed For Noise Abatement Program

Residents in the populated areas near New York City's LaGuardia Airport have complained long and loud about planes flying low over their rooftops after leaving the busy airport. To guide departing planes over Flushing Meadow, an unsettled area, a new powerful searchlight has been installed which sends a shaft of light of about 300 million beam candlepower from a point three miles beyond the end of the runway toward the airport at an angle of 30 degrees from the vertical. As planes take off,

(Continued on page 10A)

LIGHTING CALENDAR

October 11-14, 1955 — National Electrical Industries Show, 69th Regiment Armory, New York, N. Y.

October 17-21, 1955 — National Safety Council, 43rd National Safety Congress & Exposition, Chicago, Ill.

October 23-26, 1955—National Association of Electrical Distributors (Board of Governors), The Greenbrier, White Sulphur Springs, West Va.

October 24-26, 1955 — 37th Annual Meeting and Sixth National Conference on Standards, American Standards Association, Washington, D. C.

October 30, 1955—Week of—National Electrical Contractors Association, Waldorf-Astoria, New York, N. Y.

November 1-3, 1955 — Fifth Industrial Electric Exposition, Hotel Wm. Penn, Pittsburgh, Pa.

November 2-5, 1955 — National Electrical Contractors Association, Annual Convention, Waldorf-Astoria Hotel, New York, N. Y.

November 13-18, 1955—American Society of Mechanical Engineers' Diamond Jubilee Annual Meeting, Congress, Conrad, Hilton and Sheraton-Blackstone Hotels, Chicago, Ill.

November 14-18, 1955 — National Electrical Manufacturers Association, Annual Meeting, Traymore Hotel, Atlantic City, N. J.

November 14-18, 1955 — Chicago Exposition & Power and Mechanical Engineers ASME, Chicago Coliseum, Chicago, Ill.

November 28 - December 1, 1955 — Ninth Air Conditioning & Refrigeration Exposition, Auditorium, Atlantic City, N. J.

January 23-26, 1956—Plant Maintenance & Engineering Show, Convention Hall, Philadelphia, Pa.

January 23-26, 1956—National Rural Electric Cooperative Association (14th Annual Meeting), St. Louis, Missouri.

January 30 - February 3, 1956 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

February 26-29, 1956 — National Electric Sign Association, Annual Convention, Jefferson Hotel, St. Louis, Mo.

February 23-24, 1956—12th Annual National Adequate Wiring Conference, LaSalle Hotel, Chicago, Ill.

March 12-16, 1956 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

Week of June 10, 1956—National Association of Electrical Distributors (48th Annual Convention), Ambassador-Chelsea Hotels, Atlantic City, N. J.

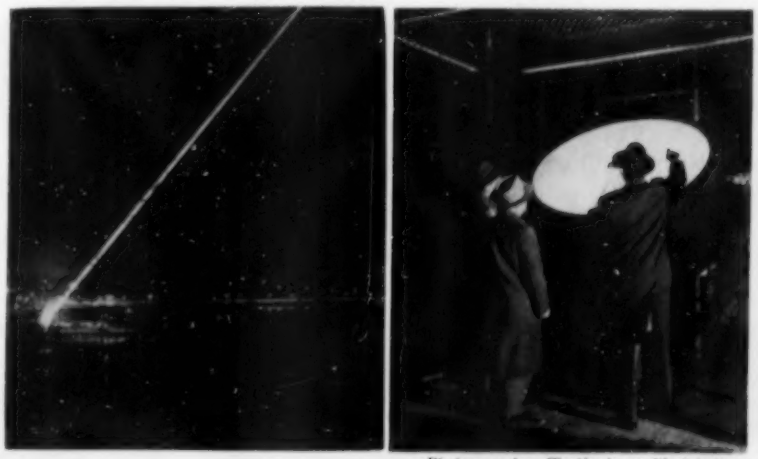
June 25-29, 1956—American Institute of Electrical Engineers, (Summer & Pacific General Meeting), San Francisco, Calif.

June 27-July 5, 1956—International Electro-Technical Committee, Munich area of Southern Germany.

October 1-5, 1956—American Institute of Electrical Engineers (Fall General Meeting), Morrison Hotel, Chicago, Ill.

October 2-4, 1956—Canadian Electrical Manufactureres Association (12th Annual Meeting), Sheraton Brock Hotel, Niagara Falls, Ontario, Canada.

November 12-16, 1956—National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.



Photos courtesy Westinghouse Electric Corp.

Beam of LaGuardia's beacon light has divergence of only one degree. At right is close-up of mounted searchlight in permanent concrete foundation and surrounded by high wire fence.

(Continued from page 9A)

they fly directly toward the beam and are led down Flushing Meadow, away from the residential areas on either side.

The searchlight itself is a 60-inch unit formerly used by the Army in connection with anti-aircraft guns. With wheels removed, it is mounted on a permanent concrete foundation. The remotely controlled 2,500-watt short arc mercury lamp used in the unit was developed at the request of the National Air Transport Coordinating Committee.

Next Summer's Meeting Planned By British I.E.S.

The British I.E.S. has extended a welcome to visitors from other countries to attend their next Summer Meeting which will be held in Harrogate, England, May 8 to 11, 1956.

The program for the meeting includes a number of technical papers, a display of new lighting equipment, visits to factories and installations and social events. The papers to be given and discussed will include:

Lighting of Small Factories.
Installation and Maintenance of Lighting Equipment.
Apparent Brightness of Light Sources.
Decorative Lighting.
Color Rendering.

Other papers planned will be by invited speakers from countries other than Great Britain.

Visits will be made to textile mills, a large garment making factory, a cocoa and chocolate factory, a lighting fixture factory and to a plant which makes most of the glass bulbs used by lamp manufacturers in Great Britain.

I.E.S. National Technical Conferences

1956 — September 17-21 — Hotel Statler, Boston, Massachusetts

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1956 Plant Maintenance Show Returns to East Coast

Making its second appearance in the eastern part of the country, the 1956 Plant Maintenance and Engineering Show, now in its seventh year, will once again be held in Philadelphia. Billed as the largest annual industrial conference in the country, the show will be held January 23-26 at Convention Hall, Philadelphia. Further information and advance registration cards may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y., producers of the exposition.

OBITUARIES

Leon Beauchamp, member of the Illuminating Engineering Society since 1922, and past Regional Vice-President of the Canadian Region, died August 28 at his home in Montreal. He was 76.

A co-founder of the Solex Company, Montreal, Mr. Beauchamp was vice-president and general manager of the firm until his retirement in 1953.

Having joined the Society as Full Member in 1922, Mr. Beauchamp was a Charter Member of the Montreal Chapter with its formation in 1935. He was Regional Vice-President of the Canadian Region from 1943 to 1945 and was an influence in bringing the National Technical Conference to Quebec for its 1945 meeting. He served as a member of the Conference Committee in 1944-1946.

A. M. Miltenberg (Chicago Section), Garden City Plating and Manufacturing Company, Chicago, Ill.

Walter C. Moore (New England Section), Litecontrol Corporation, Watertown, Mass.

Miss Lucy L. Hanan, former manager of the Home Service Division of the Sales Department of Consolidated Edison Company, New York City, was killed in an automobile accident September 15. Miss Hanan had retired last March after twenty-seven years of service.

Miss Hanan was active in the I.E.S. New York Section's Residence Lighting Forum, National Home Service committees of the Edison Electric Institute and the American Gas Association. For many years she had participated in lighting lecture demonstrations on "The Sci-

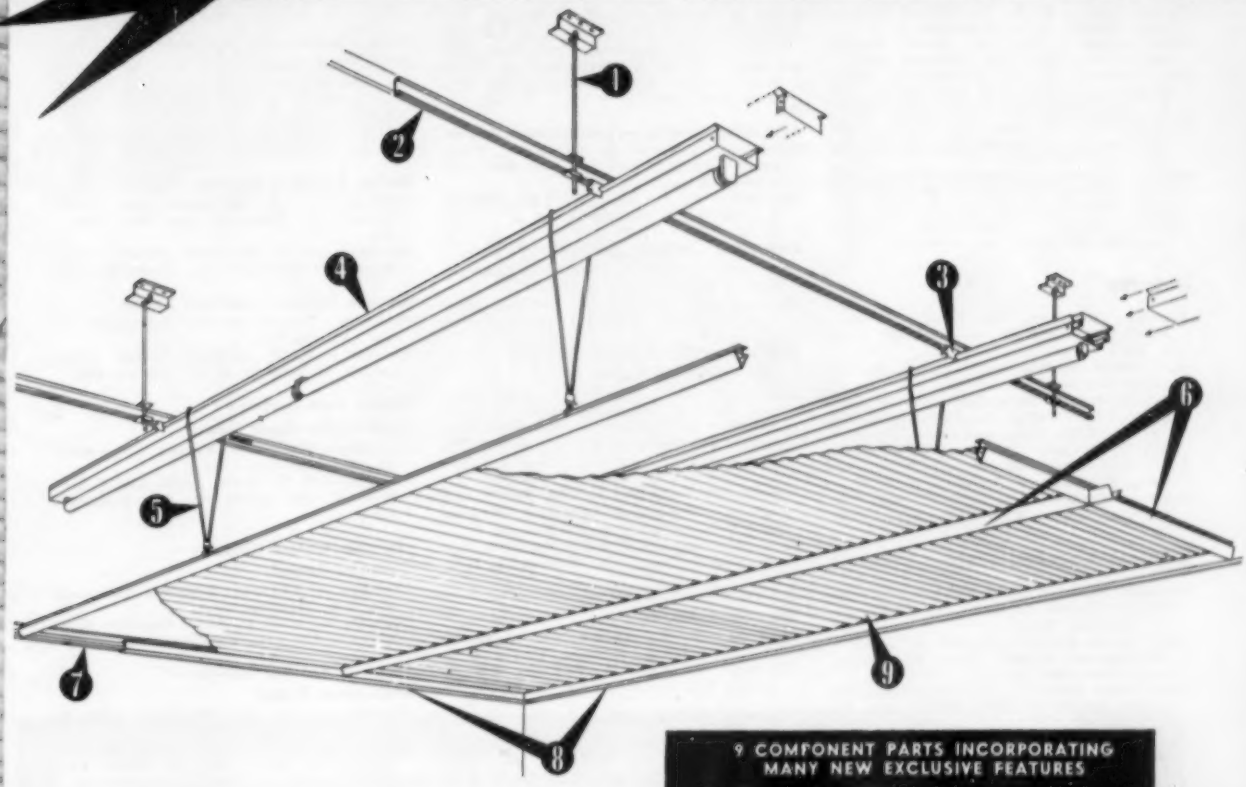
(Continued on page 22A)

New England Section members enjoy summer outing. Lobster was featured on the program.

PRESENTING

smithcraft overall illumination

"TODAY'S GREATEST VALUE IN WALL-TO-WALL LIGHTING"



Smithcraft Overall Illumination introduces a truly "custom-made" appearance to wall-to-wall lighting. Each of the corrugated plastic modules is contained in a mitred craftsmanlike framing providing an interesting accent pattern and relief from the monotony of an unbroken expanse of shielding. Framing runners are V-shaped to reflect light and eliminate annoying black bands. The entire system glows with softly-diffused light . . . uniform, comfortable and free from shadows.

Smithcraft Overall Illumination is simple and easy to install incorporating an exclusive new levelling feature which saves hours and dollars in installation. The system is installed in new construction or in remodelling projects regardless of the irregularities of the ceiling construction or of the room and regardless of the location of pipes, ducts, beams or other obstructions.

Smithcraft Overall Illumination (we call it S.O.I.) offers so many new appearance, lighting, installation and maintenance factors you really owe it to yourself to find out more about it.

Send now for the brand new folder illustrating and describing S.O.I.

9 COMPONENT PARTS INCORPORATING MANY NEW EXCLUSIVE FEATURES

1. **Hanger Assembly** — Only part attached to ceiling . . . incorporates levelling means.
2. **Supporting channel** — Levelled by hand-turning of bolts — no further levelling of system.
3. **Lighting Strip Hanger** — Slides over strip; locks to supporting channel. Location of strip may be adjusted in both directions.
4. **Lighting Strip** — Top quality Rapid-Start units with ETL—certified, Series—Sequence Ballasts. End caps become couplings in continuous rows.
5. **Runner Hangers** — Fit anywhere on strip; attach by slide fittings. Provide exact spacing — eliminate levelling difficulties.
6. **Framing Runners** — Pre-cut and mitered — lock firmly in place. V-shaped to pick up light and eliminate dark bands.
7. **Wall-channel** — Pre-cut to convenient length; no need for careful end-to-end fitting or close corner fitting.
8. **Snap-on molding** — Snap on to wall channel. Provide exact spacing for framing runners at wall.
9. **Corrugated Vinyl Sheets** — Lock in framing runners. Complies with National Building Code that these sheets shall not be over 10' in length.

Smithcraft

LIGHTING DIVISION

CHELSEA 50, MASSACHUSETTS

America's finest fluorescent lighting systems

I. E. S. National and Local Officers—1955-1956

Officers and Council 1955-1956

President — R. F. HARTENSTEIN, Ohio Edison Co., Akron, Ohio.
Vice-President — M. N. WATERMAN, Westinghouse Electric Corp., Bloomfield, N. J.
Vice-President — KIRK M. REID, General Electric Co., Nela Park, Cleveland, Ohio.
Past-President — A. H. MANWARING, Philadelphia Electrical & Mfg. Co., 1228 N. 31st St., Philadelphia, Pa.
Past-President — DUNCAN M. JONES, Curtis Lighting Co. of Canada, Ltd., 991 St. Antoine, Montreal, Que.
General Secretary — GEORGE J. TAYLOR, Day-Brite Lighting Inc., 161 E. 42nd St., New York, N. Y.
Treasurer — J. S. SCHUCHERT, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.

Directors

BROOKS CHASSAING, Board of Education Bldg., 911 Locust St., Room 31, St. Louis 1, Mo.
G. F. DEAN, Toronto Hydro Electric System, 12 Carlton St., Toronto, Ont.
C. C. SHOTWELL, Philadelphia Electric Company, 1000 Chestnut St., Philadelphia, Pa.
W. A. STANNARD, Consumers Power Company, 212 W. Michigan Ave., Jackson, Mich.
L. C. TWICHELL, Rochester Gas & Electric Corp., 89 East Ave., Rochester 4, N. Y.
JOHN S. WALSH, Pacific Gas & Electric Company, 245 Market St., San Francisco, Calif.

Regional Vice-Presidents

Canadian Region—JOSEPH THOMAS, Canadian General Electric Co. Ltd., 280 Faillon St., W., Montreal, Que.
East Central Region — NELSON C. WARNER, Westinghouse Electric Corp., 306 Fourth Ave., Pittsburgh, Pa.
Great Lakes Region — A. C. SANGSTER, The Detroit Edison Co., 2000 Second Ave., Detroit, Mich.
Inter-Mountain Region — J. D. WHITNELL, Arizona Public Service Co., P.O. Box 2591, Phoenix, Ariz.
Midwestern Region — JAMES R. CHAMBERS, Benjamin Electric Mfg. Co., Des Plaines, Ill.
Northeastern Region — C. W. McCormick, Connecticut Light & Power Co., P.O. Box 2010, Hartford, Conn.
Pacific Northwest Region — BLAIR E. PLOWMAN, The Washington Water Power Co., P.O. Box 1445, Spokane, Wash.
South Pacific Coast Region — DAN M. FINCH, University of California, Berkeley, Calif.
Southern Region—J. DIXON MITCHELL, Westinghouse Electric Corp., 2260 Peachtree Industrial Blvd., Chamblee, Ga.
Southwestern Region — JOHN G. FELTON, JR., Sylvania Electric Products, Inc., 100 Fordyce St., Dallas, Texas.

Section and Chapter Officers 1955-1956

Alabama Chapter — Southern Region
Chairman — E. B. RICHEY, 823 Comer Bldg., Birmingham, Ala.
Secretary — JOHN T. KEYSER, Alabama Power Co., 2100 N. 1st Ave., Birmingham, Ala.

Alamo Chapter — Southwestern Region
Chairman — D. V. HILEMAN, Martin Wright Electric Co., 1001 Navarro St., San Antonio, Texas.
Secretary — T. C. TELOTTE, JR., Telotte Electric Co., 1201 E. Elmira St., San Antonio, Texas.

Arizona Section — Inter-Mountain Region
Chairman — BEVAN JONES, JR., Arizona Public Service Co., Phoenix, Ariz.
Secretary — J. R. WILLIAMS, Arizona Public Service Co., 331 N. 1st Ave., Phoenix, Ariz.

Arkansas Chapter — Southern Region
Chairman — PAUL F. CRATIN, U. S. Corps of Engineers, 300 Broadway, Little Rock, Ark.
Secretary — JOHN S. WILLIAMS, Arkansas Power & Light Co., 4th & Louisiana Sts., Little Rock, Ark.

Ark-La-Tex Chapter — Southwestern Region
Chairman — CARLTON R. SHEPHERD, Southwestern Gas & Electric Co., P.O. Box 1106, Shreveport, La.
Secretary — R. C. JACKSON, Cahn Electric Co., 708 Milam, Shreveport, La.

Blue Nose Chapter — Canadian Region
Chairman — HENRY LUSHINGTON, Canadian General Electric Co. Ltd., Halifax, N. S.
Secretary — K. WILKINSON, Northern Electric Co. Ltd., 86 Hollis St., Halifax, N. S.

British Columbia Section — Pacific Northwest Region
Chairman — J. H. GILSBRATH, 3606 Edgemont Blvd., N. Vancouver, B. C.
Secretary — E. N. KOLBEINS, Associated Consulting Engineers, 1770 W. Georgia St., Vancouver, B. C.

Capital Section — East Central Region
Chairman — BENJAMIN GOODMAN, National Electric Wholesalers, Washington, D. C.
Secretary — SAMUEL W. CHARLESWORTH, General Electric Supply Co., Washington, D. C.

Central Illinois Chapter — Midwestern Region
Chairman — J. W. BROWN, Central Illinois Light Co., 316 S. Jefferson, Peoria, Ill.
Secretary — NORMAN P. FEILING, Graybar Electric Co., 704 S. Adams St., Peoria, Ill.

Central New York Section — Great Lakes Region
Chairman — WILLIAM McNULTY, JR., Graybar Electric Co. Inc., 327 North West, Syracuse, N. Y.
Secretary — JOHN J. McVEY, Niagara Mohawk Power Corp., 300 Erie Blvd., W., Syracuse, N. Y.

Central Oklahoma Chapter — Southwestern Region
Chairman — PAUL R. SHELINE, Oklahoma Gas & Electric Co., 321 N. Harvey, Oklahoma City, Okla.
Secretary — C. E. RICE, Rice Electric Co., 913 N. W. 4th St., Oklahoma City, Okla.

Chicago Section — Midwestern Region
Chairman — R. J. DIEFENTHALER, General Electric Co., 321 S. LaSalle St., Chicago, Ill.
Secretary — W. F. CARSON, Public Service Co. of Northern Illinois, Maywood, Ill.

Cleveland Section — Great Lakes Region
Chairman — G. K. WARNER, Greene & Warner, 2036 E. 22nd St., Cleveland, Ohio.
Secretary — J. G. MITCHELL, Grant Electric Co., 3016 Payne Ave., Cleveland, Ohio.

Connecticut Section — Northeastern Region
Chairman — HENRY S. KELLY, 282 York St., New Haven, Conn.
Secretary — ROBERT D. BABCOCK, General Electric Co., 185 Church, New Haven, Conn.

Cornhusker Chapter — Midwestern Region
Chairman — C. P. HAAS, General Electric Co., 14th & Farnham Sts., Omaha, Nebr.
Secretary — R. W. CHANGSTROM, Westinghouse Electric Supply Co., 117 No. 13th St., Omaha, Nebr.

Eastern New York Section — Northeastern Region
Chairman — A. E. PEABODY, 260 Delaware, Albany, N. Y.
Secretary — C. D. HOLLISTER, Niagara Mohawk Power Corp., 126 State St., Albany, N. Y.

Eastern Pennsylvania Section — East Central Region
Chairman — FORD M. GOCHENAUR, Pennsylvania Power & Light Co., Penn Square, Lancaster, Pa.
Secretary — E. W. KELSEY, Pennsylvania Power & Light Co., Harrisburg, Pa.

Florida Section — Southern Region
Chairman — J. A. SAVARESE, JR., Tampa Electric Co., Tampa & Cass Sts., Tampa, Fla.
Secretary — R. L. SIEMONS, Florida Power Corp., 908 Cleveland Ave., Clearwater, Fla.

Georgia Section — Southern Region
Chairman — JUDD LOUGH, Holophane Co. Inc., Atlanta, Ga.
Secretary — T. W. HASLAM, Georgia Power Co., 75 Marietta St., N. W., Atlanta, Ga.

Golden Gate Section — South Pacific Coast Region
Chairman — HAROLD A. WRIGHT, 225 Kearny St., San Francisco, Calif.
Secretary — C. W. MACY, Pacific Gas & Electric Co., 445 Sutter St., San Francisco, Calif.

Hamilton Ontario Chapter — Canadian Region
Chairman — CHESTER KUZNIAR, Holophane Co., Ltd., Hamilton, Ont.
Secretary — LLOYD K. HART, Canadian Westinghouse Co., Ltd., Hamilton, Ont.

Heart of America Section — Midwestern Region
Chairman — CARL W. THORSELL, 1195 E. 77th St., Kansas City, Mo.
Secretary — FRANCIS E. MILES, Frank Miles Electric Co., 821 W. 17th St., Kansas City, Mo.

Indiana Section — Midwestern Region
Chairman — EDWARD M. CHELLEW, Indianapolis Power & Light Co., Indianapolis, Ind.
Secretary — ROBERT L. PELOQUIN, Westinghouse Electric Corp., 137 S. Pennsylvania St., Indianapolis, Ind.

Inland Empire Chapter — Pacific Northwest Region
Chairman — JOSEPH M. DOYLE, 509 Realty Bldg., Spokane, Wash.
Secretary — EDWARD E. RALPH, Columbia Electrical & Mfg. Co., S. 123 Wall St., Spokane, Wash.

Iowa Section — Midwestern Region
Chairman — LEROY J. WIDIGEN, Iowa-Illinois Gas & Electric Co., 206 E. 2nd St., Davenport, Ia.
Secretary — GALE L. WILLIAMS, Iowa Public Service Co., P.O. Box 600, Waterloo, Ia.

Maritime Chapter — Canadian Region
Chairman — To be announced.
Secretary — To be announced.

Maryland Section — East Central Region
Chairman — E. R. WHITE, III, McNeill & Baldwin, Baltimore, Md.
Secretary — C. E. SPARROW, JR., Westinghouse Electric Corp., Baltimore, Md.

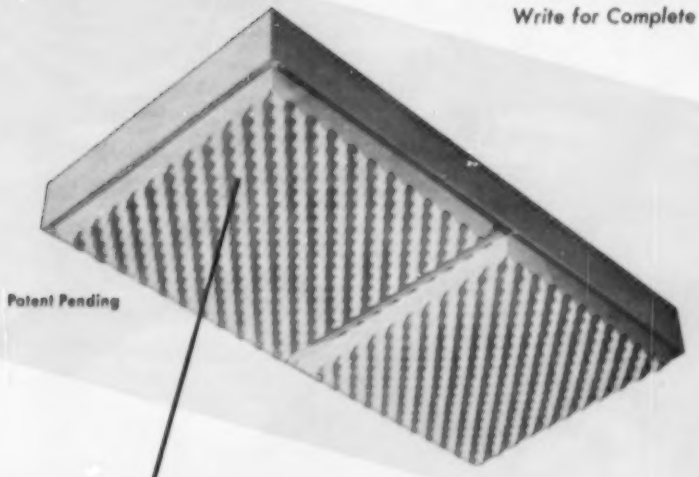
Mexico Chapter
Chairman — To be announced.
Secretary — To be announced.

(Continued on page 15A)

ALL-BRITE
Fluorescent Fixtures of California

The Sensational New AREA/LITER TRADE MARK

An Original All-Brite Development
Product of All-Brite Research
Write for Complete Brochure



Patent Pending

All-Brite's new main plant at South San Francisco—largest and most modern in the West — now expanding to over 100,000 square feet.

ask your contractor about

Controlled Lighting

All-Brite
LIGHT OF THE WEST

FLUORESCENT FIXTURES OF CALIFORNIA

Main Office and Plant: 352 SHAW ROAD • SOUTH SAN FRANCISCO
Branch Plants: 239 WEST 31ST STREET • LOS ANGELES 7
1318 S.W. FIRST AVENUE • PORTLAND 1

THREE PLANTS TO SERVE THE WEST

High Level Lighting for Faster Learning... with Lighting by **LITECONTROL**

Better lighting helps young minds learn faster, more comfortably in this remodeled Harrisburg, Pa., school. Both the original building (above) and the new wing now have their classrooms entirely lighted by LITECONTROL.

LITECONTROL fixture No. 6628 gives plenty of high intensity, low brightness illumination everywhere. Efficiency is an unusually high 86%. Light through the top of the fixture cuts fixture-ceiling contrast and helps minimize glare.

Two-piece construction means installation is fast and simple, whether the units are hung individually or in continuous rows. Maintenance is easy, too: baffles swing fully open from either side without the use of tools. Fixtures may be cleaned and relamped in seconds.

Whether your job is lighting or relighting, for a custom installation at standard fixture prices, get in touch with LITECONTROL. Call or write your local representative.

INSTALLATION: Hamilton Elementary School, Harrisburg, Penna.

ARCHITECT: Clayton J. Lappley, Harrisburg, Penna.

ENGINEER: Snyder & Van Horn, Harrisburg, Penna.

ELEC. CONTRACTOR: The Howard P. Foley Company, Harrisburg, Penna.

FIXTURE: Litecontrol No. 6628 and 6624, pendant mounted.

INTENSITY: New rooms (with fixtures hung on 8" stems), average 52 footcandles initially on desks.

Old rooms (with fixtures hung on 24" stems), average 47 footcandles initially on desks.

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Section and Chapter Officers

(*Continued from page* 12A)

Miami Valley Chapter—Great Lakes Region

Chairman — R. P. KNIESS, General Electric Co., 25 N. Main St., Dayton, Ohio.
Secretary — D. C. FIEBIGER, Dayton Power & Light Co., 25 N. Main St., Dayton, Ohio.

Michigan Section — Great Lakes Region

Chairman — EDWARD L. FAIRCHILD, Wayne University, 4841 Cass St., Detroit, Mich.
Secretary — EARL E. DOMONEY, Consumers Power Co., 600 Federal Ave., Saginaw, Mich.

Mid-South Chapter — Southern Region

Chairman — HOWARD S. CHILTON, JR., 987 Robinhood Lane, Memphis, Tenn.
Secretary — H. F. COLLINS, JR., General Electric Co., 1179 Morehead, Memphis, Tenn.

Milwaukee Section — Midwestern Region

Chairman — BEVERLY R. BUNN, Westinghouse Electric Supply Co., 546 N. Broadway, Milwaukee 2, Wis.
Secretary — WILLIAM C. KUHNKE, Wisconsin Electric Power Co., 231 W. Michigan St., Milwaukee, Wis.

Mississippi Chapter — Southern Region

Chairman — L. H. HICKMAN, General Electric Co., 403 Barnett-Madden Bldg., Jackson, Miss.
Secretary — G. W. DEANE, Mississippi Power & Light Co., P.O. Box 1640, Jackson, Miss.

Montreal Section — Canadian Region

Chairman — ALLEN G. V. SMITH, Northern Electric Co. Ltd., 1600 Notre Dame St. W., Montreal, Que.
Secretary — CHARLES MERTENS, Canadian General Electric Co. Ltd., 5000 Namur St., Montreal, Que.

Mother Lode Chapter — South Pacific Coast Region

Chairman — WILLIAM ROSS, General Electric Co., 626 Forum Bldg., Sacramento, Calif.
Secretary — G. E. HERSAM, Pacific Gas & Electric Co., 1100 K St., Sacramento 6, Calif.

New England Section—Northeastern Region

Chairman — WILLIAM B. ELMER, Wheeler Reflector Co., 275 Congress St., Boston 10, Mass.
Secretary — RALPH L. HUSE, Graybar Electric Co. Inc., Boston, Mass.

New Mexico Chapter — Inter-Mountain Region

Chairman — WILLIAM B. HILLS, P.O. Box 681, Los Alamos, New Mexico.
Secretary — TONY ROYBAL, University of California, P.O. Box 1663, Los Alamos, New Mexico.

New Orleans Section — Southern Region

Chairman — JACOB M. GENSBURGER, New Orleans Public Service Co. Inc., New Orleans, La.
Secretary — WALTER T. FABER, Louisiana Power & Light Co., 433 Metairie Rd., New Orleans, La.

New York Section — Northeastern Region

Chairman — LOUIS GOREN, Smithcraft Lighting Div., A. L. Smith Iron Co., 30 E. 40th St., New York, N. Y.
Secretary — H. A. ANDERSON, Duro Test Corp., North Bergen, N. J.

Northwestern Ohio Section — Great Lakes Region

Chairman — A. P. HAMMERSTROM, Westinghouse Electric Supply, 1225 Indiana Ave., Toledo, Ohio.
Secretary — H. W. TEEL, JR., Toledo Edison Co., Edison Bldg., Toledo, Ohio.

Ohio Valley Section — Great Lakes Region

Chairman — BEATTIE M. DELONG, 52 Woodland, Ft. Thomas, Ky.
Secretary — EDWARD J. MCGINNIS, Cincinnati Electrical Assn., 1107 Union Trust Bldg., Cincinnati 2, Ohio.

Oil Capital Section — Southwestern Region

Chairman — RAY H. BOWYER, Lawson Electric Supply, 212 So. Kenosha, Tulsa, Okla.
Secretary — W. T. WALTERS, Public Service Co. of Oklahoma, P.O. Box 201, Tulsa, Okla.

Oregon Section — Pacific Northwest Region

Chairman — DONALD W. EDMUNDSON, 325 Henry Bldg., Portland, Ore.
Secretary — DWAYNE E. SEELY, Westinghouse Electric Corp., 309 S.W. 6th Ave., Portland, Ore.

Ottawa Chapter — Canadian Region

Chairman — J. P. WILSON, P.O. Box 163, R.R. #1, Westboro, Ont.
Secretary — F. G. BOWIE, F. G. Bowie & Sons, 44 Willard Ave., Ottawa, Ont.

Palmetto Chapter—Southern Region

Chairman — GLEN M. RICE, Huntington & Guerry Electric Co., 230 Buist Ave., Greenville, S. C.
Secretary — R. NEAL CAMPBELL, 3 W. Plaza, Greenville, S. C.

Philadelphia Section — East Central Region

Chairman — G. W. WAGNER, Philadelphia Electric Co., 1015 Chestnut St., Philadelphia, Pa.
Secretary — R. L. HERR, Philadelphia Electric Co., 1000 Chestnut St., Philadelphia, Pa.

Pittsburgh Section — East Central Region

Chairman — HUGH S. JAMES, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.
Secretary—JAMES A. HODGES, Jas. H. Hodges Co., 1601 Penn Ave., Pittsburgh, Pa.

Puget Sound Section — Pacific Northwest Region

Chairman — G. DONALD KING, Sylvania Electric Products Inc., 3466 E. Marginal Way, Seattle, Wash.
Secretary — GARLAND R. BARLOGI, Sylvania Electric Products Inc., 3466 E. Marginal Way, Seattle, Wash.

Quebec Chapter — Canadian Region

Chairman — GEORGE HOPKINSON, Tri-Bec, Inc., Industrial Centre No. 5, Quebec, Que.
Secretary — VALERE MARCOUX, Northern Electric Co., 1299 Charest Blvd., Quebec, Que.

Rochester Section — Great Lakes Region

Chairman — WILLIAM S. BARCLAY, 91 St. Paul St., Rochester 4, N. Y.
Secretary — MELROSE M. FRANKLIN, Rochester Gas & Electric Co., 89 East Ave., Rochester, N. Y.

Rocky Mountain Section — Inter-Mountain Region

Chairman — GLENN B. GAES, C. B. Belt & Co., Denver, Colo.
Secretary — A. E. MCKITTRICK, 1766 Kingston St., Aurora, Colo.

St. Louis Section — Midwestern Region

Chairman — E. W. STOHLMANN, JR., Union Electric Co. of Missouri, 315 N. 12th St., St. Louis 1, Mo.
Secretary — R. D. COHEN, Glasco Electric Co., 727 N. 11th St., St. Louis 1, Mo.

San Diego Chapter — South Pacific Coast Region

Chairman — C. J. BUNCE, Electrical Contractors Division, Bureau of Home Appliances, 525 E St., San Diego, Calif.
Secretary — S. V. MONSEES, City of San Diego, 1600 Pacific Blvd., San Diego, Calif.

San Jacinto Section — Southwestern Region

Chairman — EDWARD C. OBER, Southern Electric Supply Co., P.O. Box 317, Houston, Texas.
Secretary — JOHN F. DILL, Sylvania Electric Products Inc., Dallas, Texas.

San Jose Chapter — South Pacific Coast Region

Chairman — To be announced.
Secretary — To be announced.

Southeast Florida Chapter — Southern Region

Chairman — JAMES A. FORSTER, Day-Brite Lighting Inc., 5991 S.W. 81st St., S. Miami, Fla.
Secretary — B. WALKER SMITH, Raybro Electric Supplies Inc., 745 N.W. 1st Avenue, Miami, Fla.

Southern California Section — South Pacific Coast Region

Chairman — ROY H. KREYSER, Dept. of Water & Power, City of Los Angeles, 311 S. Spring St., Los Angeles, Calif.
Secretary — MERLE A. POTTER, Smoot-Holman Co., Inglewood, Calif.

Southern Colorado Chapter — Inter-Mountain Region

Chairman — To be announced.
Secretary — To be announced.

Southwestern Section — Southwestern Region

Chairman — JOHN E. METZENTHIN, Crouse-Hinds Co., 206 Thomas Bldg., Dallas, Texas.
Secretary — ELMER L. COLE, Dallas Power & Light Co., 1506 Commerce, Dallas, Texas.

Suwannee River Chapter—Southern Region

Chairman — WILLIAM H. SADLER, Georgia Power & Light Co., 901 N. Patterson, Valdosta, Ga.
Secretary — MISS MAXINE MUSIC, Georgia Power & Light Co., 901 N. Patterson, Valdosta, Ga.

Tar Heel Section — Southern Region

Chairman — COY C. JORDAN, Carolina Power & Light Co., Raleigh, N. C.
Secretary — JAMES J. CARDO, Independent Electric Supply Co. Inc., 220 W. 1st St., Charlotte, N. C.

Tennessee Valley Section—Southern Region

Chairman — CHARLES H. PATTERSON, 300 Cumberland Circle, Donelson, Tenn.
Secretary — JOE W. FOWLER, 709 Greymont Dr., Nashville, Tenn.

Toronto Section — Canadian Region

Chairman — K. R. DUNPHY, Canadian General Electric Co. Ltd., 212 King St. W., Toronto, Ont.
Secretary — E. I. MACHTINGER, Crouse Hinds Co. of Canada Ltd., 7-21 Labatt Ave., Toronto, Ont.

Twin City Section — Midwestern Region

Chairman — CECIL H. BRANHAM, Box 27, St. Louis Park Station, Minneapolis 16, Minn.
Secretary — G. W. FREDERICK, 2135 Orchard, North, Minneapolis, Minn.

Twin Ports Chapter — Midwestern Region

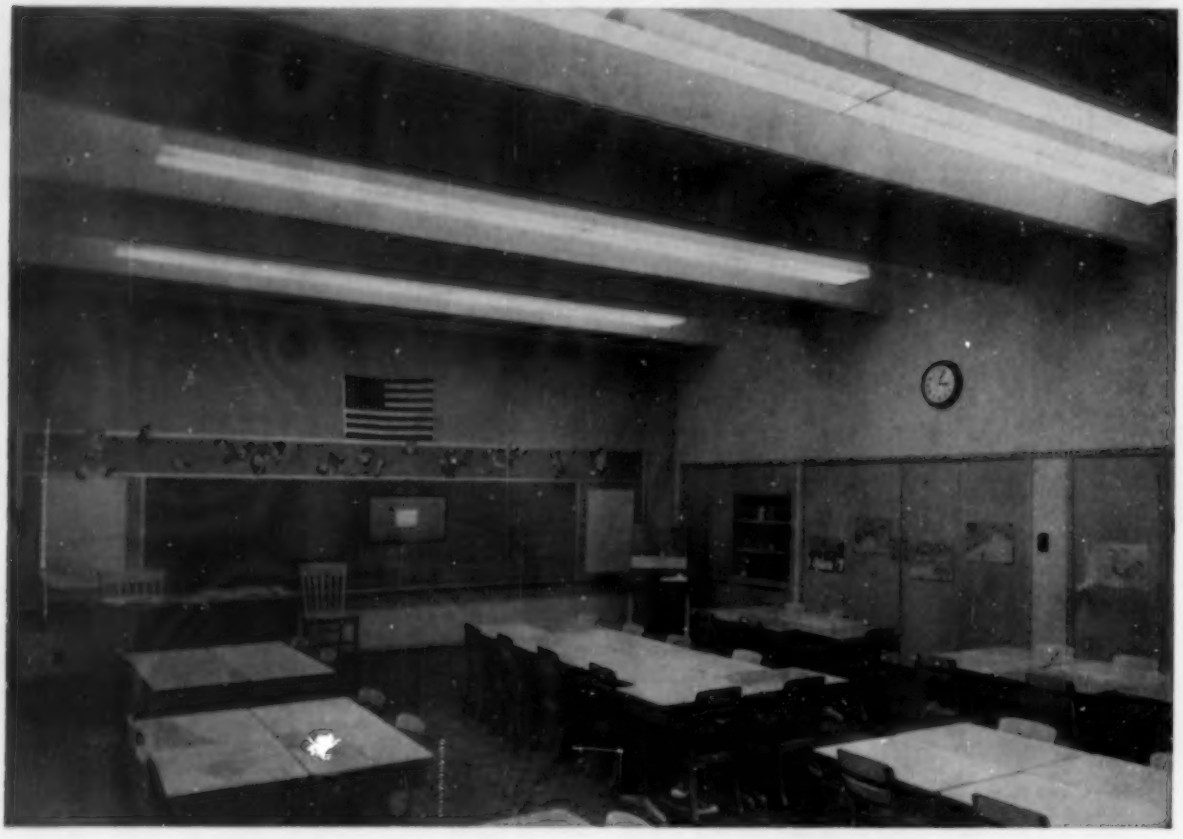
Chairman — RICHARD G. ROCKWOOD, Superior Water, Light & Power Co., 1230 Tower Ave., Superior, Wis.
Secretary — PARKER LOWELL, Minnesota Power & Light Co., 30 West Superior St., Duluth, Minn.

Utah Section — Inter-Mountain Region

Chairman — SIGURD A. BLOMQUIST, Blomquist & Brown, 235 So. 5th E., Salt Lake City, Utah.
Secretary — ROBERT W. DARGER, The Darger Co., 211 S. 2nd, West, Salt Lake City 1, Utah.

(*Continued on page* 27A)

Kind to children's eyes ... Day-Brite School Lighting



Typical classroom in the Northeast Elementary School, Danville, Illinois, equipped with Day-Brite 2-lamp Luvex® ... *Architects:* Blackman & Strader, Danville; *Electrical Contractor:* Anderson Electric Co., Danville.

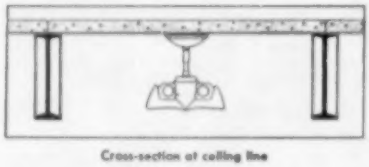
A publication of the National Society for the Prevention of Blindness,* issued in 1954, states in part as follows:

"Recent studies indicate that one child in four of elementary school age, needs eye care of some sort ..."

Undoubtedly, some corrective measures can and are being taken. Remember, though, that while glasses can correct faulty vision, they can't correct faulty lighting. Day-Brite can!

In the classroom pictured above, Day-Brite two-lamp Luvex are suspended between covered steel beams. They assure maximum eye comfort in all study areas: 60 foot-candles on desk tops, 40 foot-candles on walls, 30 foot-candles on chalk boards.

When you consider original or relighting classroom installations, SEE, EXAMINE and COMPARE Day-Brite with any other lighting system. Look at the fixtures, not just the pictures.



Cross-section at ceiling line

"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

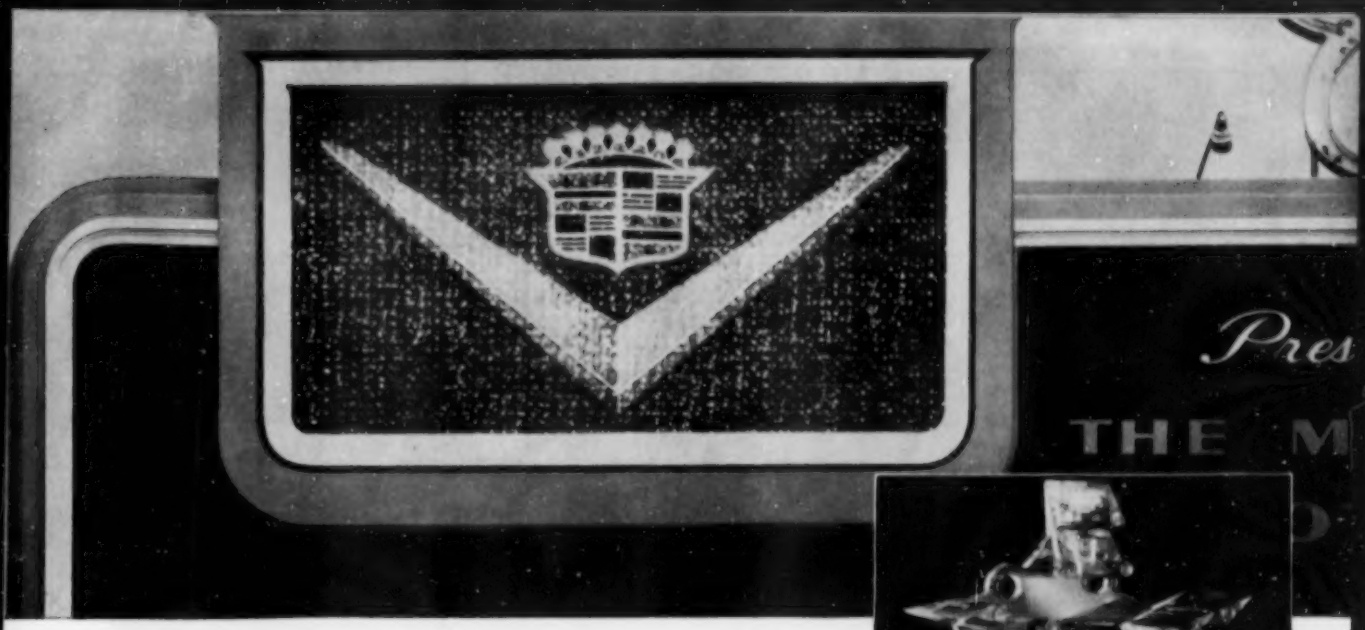
Call your Day-Brite school-lighting specialist!

Day-Brite Lighting, Inc., 5432 Bulwer Ave., St. Louis 7, Missouri
In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Canada

**A Survey of College Health Programs for Prospective Teachers—with Special Reference to Eye Health.*

5491

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT



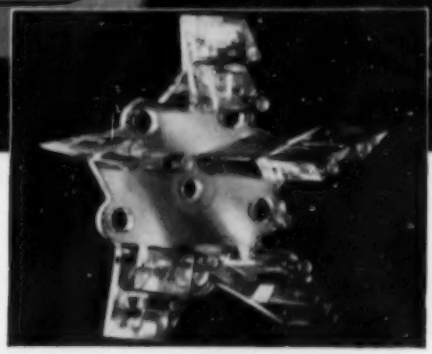
What's behind this spectacular's new sparkle?

40,000 REVOLVING PRISMS OF DU PONT *LUCITE®*!

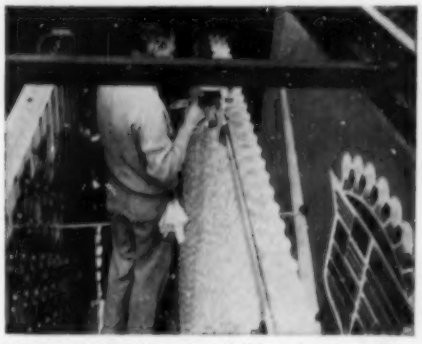
Housed directly behind the emblem on this new outdoor sign are 40,000 prisms molded of "Lucite" acrylic resin, stacked on 49 columns. The prisms rotate, catching the light from a battery of lamps and breaking it up to create sparkling, jewel-like effects. These effects are visible at great distances. Even in daylight or fog, the sign has an extraordinary brilliance.

Why was "Lucite" acrylic resin chosen for these prisms? The designer of this unique sign, Rudolf Pabst, President of Prism Signs, Inc., San Mateo, California, explains: "We use 'Lucite' because of its superior light-transmitting properties. It resists breakage and high heat, and stands up well to weathering. Another consideration – 'Lucite' acrylic resin can be molded efficiently and economically."

For further information on "Lucite" for signs – as well as data on "Lucite" for lighting applications – mail the coupon.



CLOSE-UP of the 25° injection-molded prism of "Lucite" acrylic resin. The designer found "Lucite" an excellent material for this application – with outstanding optical properties, strength and weather resistance.



RUDOLF PABST, inventor of this unique spectacular, checks a prism rotor. Tough, durable gears and bearings of "Zytel" nylon resin are used to assure dependable operation of the 49 shafts on which the molded prisms are mounted. Bearings and gears molded of "Zytel" nylon resin require little or no lubrication. Parts molded by American Molding Company, San Francisco, California.

Good Lighting Is Good Business

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. DU PONT DE NEMOURS & CO. (INC.)
Polychemicals Department
Room 2810 Du Pont Bldg., Wilmington 98, Del.
In Canada: Du Pont Company of Canada Limited,
P. O. Box 660, Montreal, Quebec

Please send me more information on extruded "Lucite" acrylic resin. I am interested in "Lucite" for: LIGHTING APPLICATIONS ☐; SIGNS ☐.

*Name*_____

*Position*_____

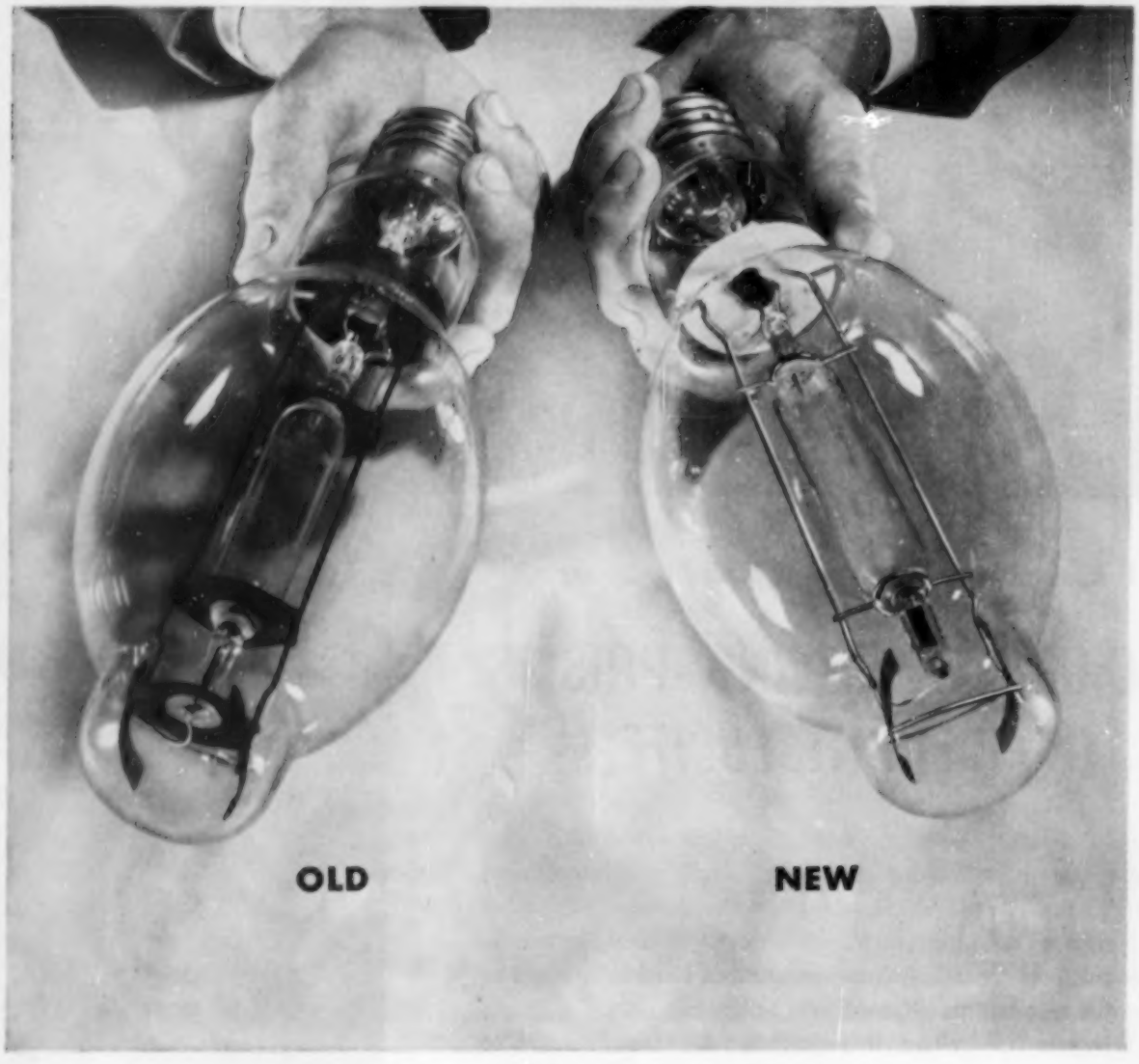
*Firm Name*_____

*Street Address*_____

*City*_____ *State*_____

*Type of Business*_____

G-E LAMPS GIVE YOU MORE FOR ALL YOUR LIGHTING DOLLARS



New, radically improved G-E mercury lamps substantially reduce the cost of mercury light!

EACH of the General Electric mercury lamps, in the picture, use 400 watts of electricity. But the new 1955 lamp gives 10% HIGHER LIGHT OUTPUT than the old model. There are FEWER EARLY BURNOUTS—those that occur before the lamp has burned 3,000 hours. These are down by more than half. And the new lamp has LONGER LIFE. It is so much longer that—for the first time in mercury lighting history—it is now rated on *economic* life rather than on *burnout* life.

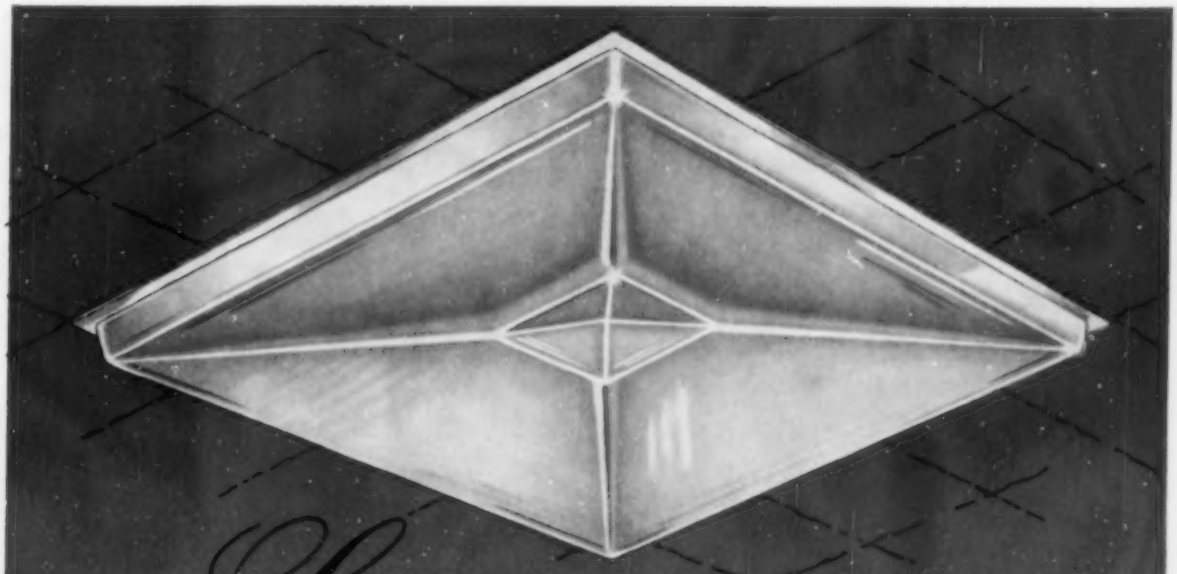
Counting lamps, maintenance labor and electricity—the new lamp gives a bonus of light worth about $9.00 compared to last year's model.

Above, you can see two of the ways General Electric has improved the lamps. Compare the little metal structures inside the lamps. In the early 1954 model, left, the structure is bulky and dark. It blocks and absorbs a lot of light. In the new lamp it's slimmer, so it lets more light out. And it's silver plated, so it reflects the light that does hit it.

The lamp above is only one example. Other G-E mercury lamps have been radically improved, too. Yet most types cost *less* than before the improvements were made! To find what they can mean to you in dollars and cents, send for the new 12-page bulletin on G-E mercury lamps. It's free, just write Large Lamp Department, General Electric, Dept.482-IE-10, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC



for *Luxury* lighting...

GARCY 5600 Series

Recessed Luminaires

featuring one-piece plastic shield
in 2′ x 2′, 2′ x 4′ and 4′ x 4′ units

In this series Garcy offers the highest quality lighting with a choice of three types of shielding . . . all in hinged frames:

Plexiglas shield—The unique die-formed contour gives uniform low brightness and provides the rigidity which permits a one-piece diffuser to be used even in the large 4′ x 4′ unit.

Louver shield—Lightweight, completely framed and tab-locked into a one-piece assembly for convenient maintenance, superior appearance and greater durability.

Glass shield—Standard is Corning Alba-Lite, fine-ribbed translucent opal glass, an excellent diffusing medium. Other types of glass are available as desired.

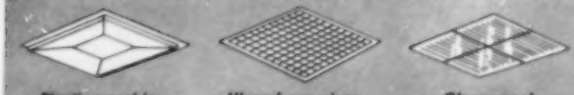
Sturdy, rigid frames provide secure mounting, and are designed to prevent light leaks around edges.

Send for Bulletin 552-L

GARCY Quality by *Design*

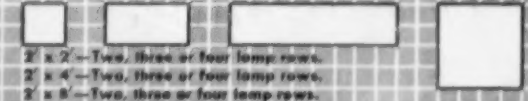
Garden City Plating & Mfg. Co., 1760 N. Ashland Ave., Chicago 22, Ill.
In Canada: Garcy Co. of Canada, Ltd., 191 Niagara St., Toronto

THREE TYPES OF SHIELDING



Plastic panel in hinged frame | Hinged one-piece louver | Glass panel in hinged frame

VARIETY IN SIZE AND NUMBER OF LAMPS

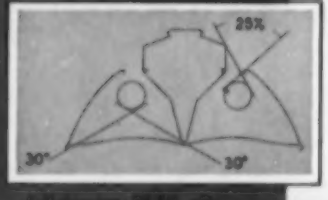


2′ x 2′—Two, three or four lamp rows.
2′ x 4′—Two, three or four lamp rows.
2′ x 8′—Two, three or four lamp rows.
4′ x 4′—Six, eight or ten lamp rows.
Choice of rapid start fluorescent or slimline lamps.

AN INDUSTRIAL SO REVOLUTIONARY IT CUTS INSTALLATION COSTS 50%

GIBSON

ortho-88®



- **SAVES ON CONDUIT, RECEPTACLES, ACCESSORIES**
- **ELIMINATES ALIGNING EXTRAS, Y CHAINS, CORDS AND PLUGS**

The exclusive features of the Gibson Ortho-88 make it possible to enjoy superior industrial lighting at the cost of ordinary installations.

The Uni-Race, to which units are later attached, is easily assembled into sections up to 24 feet long and wired completely *on the floor*, except for final service connection. It is raised and hung as a unit—directly to bar joists, beams or stems. Alignment and spacing for fixtures is automatic.

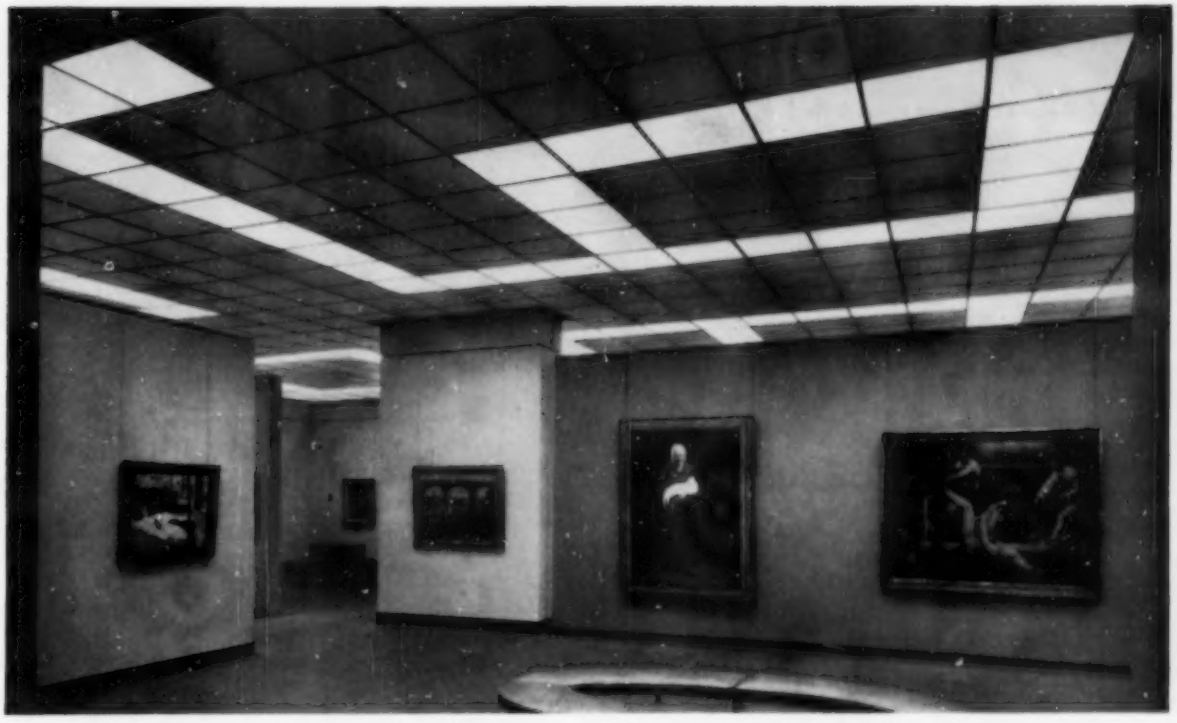
The Uni-Race provides power for temporary lighting and tools. When the building is ready for occupancy, spotless fixtures can be snapped into place by two men, without tools, at the rate of 45 to 55 units per hour—in continuous rows or at intervals of 4, 8, 12 or more feet. Spacing can be changed, more units added, repairs made—all without interrupting service to other fixtures on the circuit, or additional electrical work.

The result is a top-quality installation with savings on materials and labor up to 50%.

Get all the facts in our Ortho-88 bulletin, which we'll gladly send on request, and you'll see why it pays to use the Ortho-88.

Gibson LIGHTING

GIBSON Manufacturing Co.



In this painting gallery at the Whitney Museum, the panels of Alba-Lite are dimmed to show the location of the Fota-Lite panels. Louvers are photographically produced in Fota-Lite to transmit light at a 30° angle in this installation. Direct illumination on vertical surfaces at eye level totals 65 foot-candles. Fota-Lite also comes with louvers designed for 45° cutoff.

Whitney Museum of American Art, New York
Architect: Auguste Noel, A.I.A.
Lighting Consultant: Thomas Smith Kelly
Fixtures: Century Lighting

How the new Whitney Museum lights its galleries

Luminous ceilings in the new Whitney Museum of American Art in New York create an environment of beauty for the appreciation of beauty.

And they provide almost natural light illumination. *In the painting galleries,* two systems of lighting are combined in one luminous ceiling. The entire ceiling is made up of 24″ x 24″ panels of Corning Lighting Glassware, framed in metal muntins and suspended from the structural ceiling.

Panels of Corning Alba-Lite provide low brightness illumination for the central areas. Panels of Corning Fota-Lite direct lighting to vertical surfaces where paintings are hung.

In the sculptural gallery a luminous ceiling of Alba-Lite transmits soft, glare-free lighting. At certain points, ceiling panels can be removed so that bullet spotlights or other special lighting can be used to emphasize some special piece of sculpture.

These functional, flexible lighting installations are outstanding examples of the almost limitless range of application possible with Corning Engineered Lighting Glassware. From large 36″ x 100″ panels of Alba-Lite to small 6⅜″ Lenslites, you may choose lighting glassware designed specifically to meet your need.

You will find Corning Engineered Lightingware in your Sweet's Catalog, or for complete specification plus technical data, write for your free copy of the "Architects and Engineers Handbook of Lighting Glassware."

The luminous ceiling in this sculpture gallery is of Corning Alba-Lite—a light opal glass designed especially for smooth diffusion and excellent brightness control. Alba-Lite is not color selective.

CORNING GLASS WORKS
CORNING, N. Y.

Corning means research in Glass

CORNING GLASS WORKS, 69-10 Crystal Street, Corning, N. Y.
Please send me a copy of the "Architects and Engineers Handbook of Lighting Glassware."

Name..... Title.....
Company.....
Address.....
City..... Zone..... State.....

(Continued from page 19A)

ence of Seeing," and "Light and Color in the Home" before consumer groups.

At the time of her retirement, she was assisting in the company's Sales Department's newly formed Adequate Wiring Bureau.

ABOUT PEOPLE

Roland Hoot, Philadelphia Electric Co., and member of the I.E.S. Street and Highway Lighting Committee; and **C. A. Douglas,** National Bureau of Standards, were appointed to attend the September 13 meeting of The President's Committee for Traffic Safety, representing the I.E.S. The meeting was held in Washington, D. C., to discuss the ways to aid in attaining the objectives of S-D Day — December 1, 1955, which is part of the 1955 Safe Driving Program.

The 1955 Journal Award of the Society of Motion Picture and Television Engineers has been won by **Richard S. O'Brien** of the Columbia Broadcasting System. The award was presented to Mr. O'Brien, October 4 during the Society's 78th Convention at the Lake Placid Club, Essex County, N. Y. The Journal Award is given to "the author of the most outstanding paper originally published in the journal of the Society during the preceding calendar year." Mr. O'Brien was selected for his paper "CBS Color Television Staging and Lighting Practices" which appeared in the August 1954 issue of the *SMPTE Journal.*

General Electric Co. has announced the election of **William A. Mann** of Chicago as a commercial vice-president, assigned as resident officer in a newly-established regional headquarters in St. Louis. Mr. Mann has been central district manager of the company's User Industry Sales Department in Chicago. The new vice-presidential territory covers the states of Missouri, Kansas, Kentucky and parts of five others.

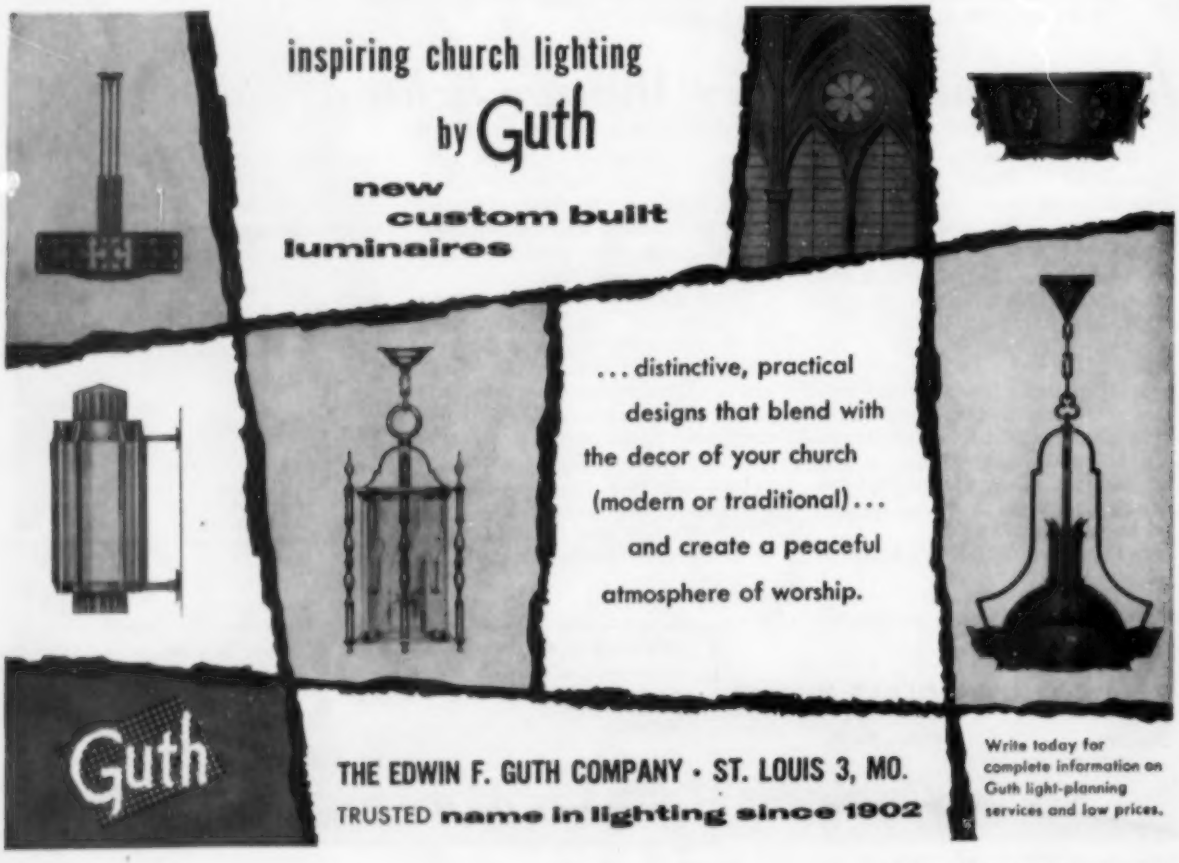
James H. McCulloch has opened a photometric testing service, The Independent Testing Laboratories, in Boulder, Colo. The new firm, which opened October 1, will also be available for design consultation for fixture manufacturers and others. Mr. McCulloch was previously Product Planner for the General Electric Ballast Division in Danville, Ill. and before that had been Development Engineer with Sunbeam Lighting Co. in Los Angeles.

The board of directors of the Kuhlman Electric Co., Bay City, Mich., has announced the election of **George R. Fluehr** to the company presidency. Formerly secretary-treasurer, Mr. Fluehr will remain treasurer in addition to his new duties. **H. E. Greenwalt** has been named executive vice-president and secretary and general manager.

Billy L. Cook has been named Smithcraft Lighting's representative in the Texas and Oklahoma area. Mr. Cook has been a consulting engineer in the lighting field for the past few years.

Wayne D. Baker has been appointed manager of the South Central sales district of Westinghouse Electric Corp., Lamp Division. Mr. Baker will make his headquarters in New Orleans, and will be responsible for the company's lamp sales in Louisiana, southern Mississippi, the southwestern corner of Alabama and in western Florida. He was previously assistant to the regional manager in the Atlanta office.

(Continued on page 25A)



This electrical surge test is one of the 258 tests that every G-E ballast receives during the manufacturing cycle. This test subjects G-E ballasts to the most severe conditions they will ever encounter in actual operation; assuring you of long ballast life and low lighting costs.

Flora* shows you why . . .

Superior Quality Control of G-E Ballasts Helps You Save Lighting Dollars

Lighting engineers, designers, and users have learned to depend upon the consistently high quality of General Electric fluorescent lamp ballasts.

They know that the rigid material specifications and constant production line tests mean uniformly good ballasts; save lighting dollars by minimizing early replacement and maintenance costs.

Starting with raw steel and copper wire at the receiving dock and ending only when the finished ballast is loaded for shipment, G-E quality control engineers constantly test raw material and ballast parts to meet rigid mechanical and electrical requirements.

By actual count a G-E ballast receives 258 different tests and checks before packing and shipment! This painstaking care pays off to you in highly dependable operation, efficient lamp output, and long ballast life—it saves you valuable lighting dollars.

Next time you specify equipment for a fluorescent lighting installation, make sure you get the best...specify General Electric quality-controlled ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with the best in ballast value. It's the easy way to be certain. For further information on G-E ballasts, write Section 401-9, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G. E.'s Ballast Mascot

Copyright 1955, General Electric Company

CLOSE INSPECTION of each component assures you of high quality ballasts, lower lighting costs and dependable performance.

Five more reasons why

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- **EXCLUSIVE SOUND RATING SYSTEM**
- **LONGER BALLAST LIFE**
- **PRECISE LAMP-MATCHED DESIGN**
- **PROVED PRODUCT LEADERSHIP**
- **COMPLETE CUSTOMER SERVICES**

Progress Is Our Most Important Product

GENERAL ELECTRIC

solve your picture lighting problems by using

KLIEGL PINHOLE DOWNLIGHTS

Sketch shows light rays focused within picture area only.

Relatively small flush-type ceiling fixtures equipped with an objective lens system and framing shutters for adjusting beam spread and shape to cover any size painting.

Provides high intensity, direct illumination covering a sharply defined area with concentrated light.

New, 36-page brochure, A-11-C, sent on request. Contains comprehensive architectural and engineering information on Downlights, Wall Washers, other new and different lighting equipment.

KLIEGL BROS

UNIVERSAL ELECTRIC STAGE LIGHTING CO. Inc.

ORIGINATORS and MANUFACTURERS of KLIEGLIGHTS

321 West 50th Street New York 19, N. Y.

WILEY Offers: STARTER TYPE, RAPID START AND SLIMLINE LIGHTING FIXTURES Commercial and Industrial

WILEY PIONEERED

WILEY DESIGNED

WILEY MANUFACTURED

Modern, functional designs to harmonize with any architectural motif.

Stock fixtures adaptable for all lighting layouts.

Units designed for quick, easy erection; a minimum of "on the job" assembly.

Patented E-Z Servicer.

District Sales Engineers available for prompt cooperation.

Designed and Completely manufactured by WILEY, pioneers in Fluorescence since its inception — with ETL Certified Electrical Components.

FOR FULL INFORMATION WRITE

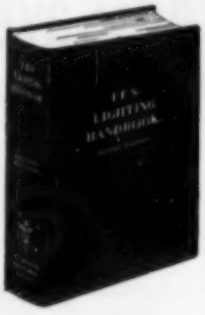
R & W WILEY Inc.

Dearborn at Bridge Street

BUFFALO 7, N. Y.

Underwriters' Approved — IBEW (A.F. of L.)

Is *YOURS* The Latest?...



You can't be sure you have *all the facts* about lighting unless you have a copy of the new . . .

Second Edition

I.E.S. LIGHTING HANDBOOK

Prepared by I.E.S. technical committees, this 987-page lighting compendium contains 18 sections of lighting practice, theory and calculations . . . Appendices . . . Manufacturers' Reference Data . . . 655 photos, drawings, lighting tables, charts, graphs, to help you solve tough lighting problems.

If your problems are lighting problems, don't be another day without the new I.E.S. LIGHTING HANDBOOK.

Price . . . $8.00

I.E.S. Members: If you have not ordered, your special member copy is only $5.50 now.

ORDER NOW!

Publications Office

ILLUMINATING ENGINEERING SOCIETY

1860 BROADWAY NEW YORK 23, N. Y.

(*Continued from page 22A*)

Pittsburgh Reflector Co. has named **Paul F. Stiller** to take charge of the company's southern Ohio office covering Cincinnati, Columbus and the balance of southern Ohio, as well as Kentucky and most of West Virginia. His headquarters will be in Newtown, Ohio, a suburb of Cincinnati. Mr. Stiller was previously in the Cleveland office of the company.

BOOKS AND PAMPHLETS

Farmstead Wiring Handbook, Revised Edition. Published by the Industry Committee on Interior Wiring Design; available from the Edison Electric Institute, 420 Lexington Ave., New York, N. Y. 48 pages, $.50 per single copy.

New upgraded wiring standards for America's farms are set forth in this revised edition, which supersedes the original publication of 1946. The present manual lists the minimum recommendations which in the electric industry's opinion are necessary if the farm is to be adequately wired for present and future needs. It recommends and suggests such items as sizes of wire, number and locations of outlets to help the farmer improve the efficiency, convenience and adequacy of his electric service. The handbook is divided into three sections: interior wiring design, outdoor electrical distribution, and a series of tables showing wire sizes to carry various electrical loads.

McGraw-Hill Author's Book, McGraw-Hill Book Co., 330 West 42nd St., New York, N .Y. 88 pages. $3.00.

This "author's guide" compiled by a publisher of technical books presents information on the preparation of manuscripts and illustrations for scientific and engineering material on its way to publication. Much of this information, although demonstrating the typographic style and editorial procedure of a specific book publisher, is equally applicable to all technical publications, such as: lettering size on drawings to permit reduction; presentation of mathematical material and formulas; corrections made on typewritten manuscripts—and the chronic and insistent headache of meeting the deadline.

IEC Document No. 75, Porcelain Insulators for Overhead Lines, 40-page booklet, published by the International Electrotechnical Commission, available from the American Standards Association, 70 East 45th St., New York 17, N. Y. $2.40. This international standard contains recommended tests for the correct dimensions of insulators, for performance, and tests for quality to determine defects which may have occurred in the manufacturing process.

Accident Facts, 1955 Edition, National Safety Council, 425 North Michigan Ave., Chicago, Ill. 96 pages. $.75 per single copy.

This statistical yearbook contains facts and figures on a wide range of accidents — industrial, traffic, home, farm and school. Twenty pages are devoted exclusively to occupational accidents and provide a background for industrial safety programs.

To Enrich Mankind, 25-minute color motion picture, prepared for the American Society of Mechanical Engineers as part of their 75th anniversary celebration, is available on loan without charge to schools, television stations and nonprofit organizations. A production of the Jim Handy Organization, the film describes the benefits which the mechanical engineering profession has brought to our economy, and the individuals in it.

SUNBEAM LIGHTING MAKES SMALL OFFICES BIG

Look carefully at the Sunbeam lighting installations below which lend a "big" look and a feeling of spaciousness to small offices. See how Sunbeam luminaires help to develop decorative themes, add architectural interest and provide the kind of quality illumination on which Sunbeam Lighting has built its proud name. From small offices to large commercial and industrial interiors there's a Sunbeam Visionaire engineered to meet your most exacting requirements for long-lasting lighting quality, installation simplicity and architectural integrity of design.

Continuous rows of recessed H9040 Series

arrangement of Sunbeam DV7700 Series

HDP3800 Series with molded Plexiglas

SUNBEAM LIGHTING COMPANY
777 E. 14th Place, Los Angeles 21, California

LOOK OUT FOR THE LIGHT-HAWK

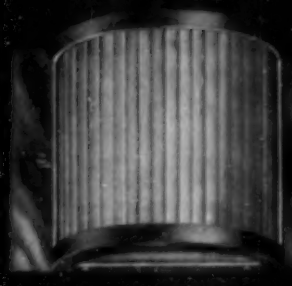
The keen-eyed *Light-hawk* swoops down wherever lighting maintenance lags and flies away with power dollars. You can stop him by following the principles of good lighting practice presented in the *Champion Maintenance Manual** and seeing that the dependable name CHAMPION is on the lamps you use.

CHAMPION *Lamps*

**Write today for a complimentary copy.*

CHAMPION LAMP WORKS
306 Lynnway, Lynn, Massachusetts

design by mcPhilben



An Exterior Wall Bracket—4-50

Here's durability and performance . . . in a distinctive modern design

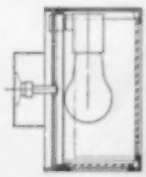
Striking in its simplicity . . . designed for long-lasting, all-weather protection . . . maximum efficiency, wherever lighting fixtures take a beating.

IT'S MADE OF heavy die-cast aluminum throughout . . . satin-finished . . . anodized for protection against sun, rain, dampness.

THE UNIT INCLUDES a medium base twin porcelain lamp holder for one 150-Watt inside-frosted lamp and Flutex curved glass diffusers. The assembly is simple . . . a hinged door frame secured to a back plate with a captive held screw.

APPLICATIONS COVER . . . schools, hospitals, libraries, railway and bus stations, factories, public and office buildings . . . all institutions!

FOR OTHER WALL BRACKETS in exterior line, write for data on . . . the "4 line". DIMENSIONS—(4-50) 8" high, 11" wide, with a 4⅛" projection from the wall.



1329 Willoughby Avenue, Brooklyn 37, N. Y.

CONSULT mcPhilben *Lighting* SPECIFY

Representatives in major cities. Stocked By Electrical Wholesalers

Section and Chapter Officers

(*Continued from page 15A*)

Vancouver Island Chapter — Pacific Northwest Region

Chairman — A. C. F. Evans, 1654 Monterey Avenue, Victoria, B. C.

Secretary — G. R. F. Geddie, British Columbia Electric Railway Co. Ltd., 1501 Douglas St., Victoria, B. C.

Virginia Chapter — East Central Region

Chairman — Lynn W. Ferguson, 3119 Bute Lane, Richmond 21, Va.

Secretary — Robert R. Buchanan, Sylvania Electric Products Inc., 2520 Oakville St., Alexandria, Va.

Western Michigan Section — Great Lakes Region

Chairman — L. G. Thompson, Independent Electric Co., Muskegon, Mich.

Secretary — D. A. Harper, General Electric Supply Corp., Grand Rapids, Mich.

Western New York Section — Great Lakes Region

Chairman — Willard E. Hayes, General Electric Co., 438 Delaware Ave., Buffalo, N. Y.

Secretary — Fred R. Pfalzgraf, 1612 Main St., Buffalo, N. Y.

Winnipeg Chapter — Canadian Region

Chairman — A. McDowell, B. A. Robinson & Co., 287 Sherbrooke St., Winnipeg, Man.

Secretary — D. J. Bourdon, Amalgamated Electric Co., 677 Notre Dame Ave., Winnipeg, Man.

Employment Opportunities

ENGINEER WANTED

For Midwest consulting engineering office. Must be at least forty years old and have a minimum of fifteen years' experience in design of lighting, power distribution, and sub-stations for commercial, industrial and institutional buildings. Excellent opportunity for top notch man. Address Box 245, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

DESIGNER-DRAFTSMAN WANTED

Free lance or permanent. Top-notch man. Fluorescent and contemporary lighting fixtures. Must have complete background of construction details, etc. Address Box 246, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

SALES EXECUTIVE AVAILABLE

With extensive background of over 20 years in lighting field; engineering, design, manufacturing, sales. Has operated own company as manufacturers' representative. Desires connection with manufacturer seeking sales on Atlantic Seaboard, Maine to Florida, in sales executive capacity. Address Box 247, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

MANUFACTURERS' REPRESENTATIVE AVAILABLE

Established, successful firm covering New England and the Northeastern states desires additional lines to be sold principally through Architects and Engineers. Address Box 249, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

IF YOU CAN USE A MAN WHO —

has many years of experience in working with prominent engineers and architects on lighting problems; has layed out the lighting and designed and sold the necessary equipment for some of the most prominent public buildings in the country; understands manufacturing procedures and can make shop drawings; write to Box 250, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

SALESMEN — REPRESENTATIVES

All territories, to call on wholesale trade and architects with a complete line of fluorescent, slimline and new plexiglass 2 x 2 and 4 x 4 squares, etc. Excellent opportunity for high caliber men to make money. Liberal commission, protected territory. Write giving full information on lines carried and territory covered. Mercury Electric Co., 207 S. 13th Ave., Mt. Vernon, N. Y.

LIGHTING SALES — ENGINEER

VIRGINIA-WASH, D. C.-BALTIMORE

Seek: Experienced salesman with ambition, drive, and yen to make more money. Should be well-versed in all phases of the lighting field . . . engineering or technical background helpful. Must be able to travel . . . work with architects and engineers on specifications, sell to distributors, pre-sell contractors.

Offer: A full-time career selling our lines *exclusively* in the Virginia-Washington, D. C.-Baltimore territory . . . guaranteed salary *plus* incentive plus powerful promotional backing. We are fast-growing *manufacturers* of complete lines of competitively priced lighting designs for *all* applications. Our quality and service are the envy of the industry. This territory is now active and profitable leader. We are being specified and displayed. This opening is due to a long-range expansion of our facilities, lines and promotions. Send full details to: Box 248, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

LIGHTING SALES REPRESENTATIVE

Large nationally known manufacturer of complete line incandescent, fluorescent, slimline fixtures and louvered ceilings selling only through wholesalers is redistributing territories and has openings for:

- State of New Jersey
- State of Maryland & D. C.
- New England States

Man applying should have following among architects and electrical engineers. Write full details in first letter giving past experience. Our men know of this ad. All replies strictly confidential. Address Box 251, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

The Most Elaborate Lighting in Television Specified VICKERS® Magnetic Amplifier Type Dimmers

- DEPENDABLE
- NO TUBES OR MOVING PARTS
- INHERENTLY STABLE
- GREATER EFFICIENCY
- FAST RESPONSE
- FLEXIBLE LOAD CAPACITY
- REMOTE CONTROL
- SPACE SAVING EASILY INSTALLED

WRITE TODAY for new lighting control bulletin.

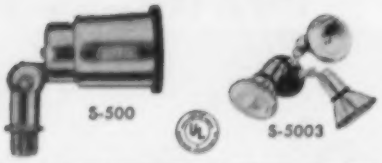
VICKERS ELECTRIC DIVISION

VICKERS Inc.

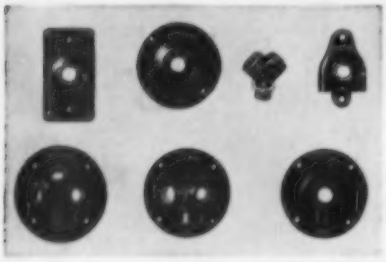
1863 LOCUST STREET • SAINT LOUIS 3, MISSOURI

LIGHTING AT ITS ECONOMICAL BEST...

STEBER FLOODLIGHTS AND SEALED BEAM COMPONENTS



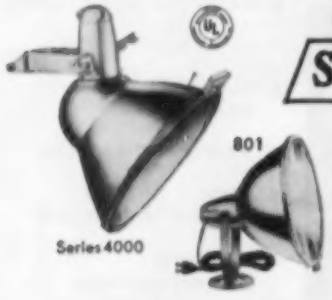
CHROME PLATED STEBERLITES WITH FITTINGS FINISHED IN RICH BLACK!



Lustre—liveliness—sales appeal! Chrome plated Steberlites have it! The brilliant plated surface of the S-500, richly contrasted by deep black weatherproof lamp gasket and mounting flanges finished in colonial black, provides that magic touch which makes a Steberlite installation outstanding. S-500 Steberlites are fully adjustable, are factory wired and accommodate PAR-38 and R-40 medium base lamps. The mounting flanges provide for easy attachment to wall or pole, switch or outlet box—in single, two or three lamp combinations.

STEBER VAPORTITE FIXTURES

Especially designed for both indoor and outdoor use. Heavy cast aluminum construction resists moisture, salt spray, smoke, non-explosive dust, gas and most chemical fumes. Extra thick cork gaskets provided for perfect seal between splice box and fixture and glass globe and fixture cap. Types for mounting to outlet box or to vertical or horizontal ½" conduit or pipe. Each unit can be furnished with welded wire guard to protect globe from breakage. For 100 or 200 watt lamp.



OPEN AND ENCLOSED STEBER FLOODLIGHTS

Economical Steber floodlights are available in both open and enclosed types for lamps from 100 to 1500 watts. Each unit has ample wiring compartment (or is fully wired with cord and plug), and versatile mounting bracket for quick, easy installation. Ideal for all industrial, commercial and sports areas.

New Steber Catalog TDS-9 gives complete details. Write now.

STEBER MANUFACTURING CO.
DEPT. 74, BROADVIEW, ILLINOIS

STEBER

Steber Manufacturing Co. of California
242 So. Anderson St.
Los Angeles 33, California

Steber-Woodhouse Ltd.
33 Ingram Drive
Toronto, Canada

INDEX TO ADVERTISERS
October 1955

Champion Lamp Works	26A
Corning Glass Works	21A
Curtis Lighting Inc.	4A
Day-Brite Lighting Inc.	16A
E. I. du Pont de Nemours & Co. Inc.	17A
Fluorescent Fixtures of California	13A
Garden City Plating & Mfg. Co.	19A
General Electric Co., Apparatus	23A
General Electric Co., Accessory Equipment	7A
General Electric Co., Lamp	18A
Gibson Manufacturing Co.	20A
Edwin F. Guth Co.	Back Cover, 22A
Kliegl Bros.	24A
Litecontrol Corp.	14A
R. A. Manning Co.	29A
McPhilben Manufacturing Co.	26A
Mitchell Manufacturing Co.	29A
RLM Standards Institute	Inside Back Cover
Sheffield Plastics Inc.	29A
Smitheraft Lighting Division	11A
Sola Electric Co.	8A
Starring & Company Inc.	2A
Steber Manufacturing Co.	28A
Sunbeam Lighting Co.	25A
Sylvania Electric Products Inc.	30A
Vickers Lighting Division	27A
Wakefield Company	Inside Front Cover
Westinghouse Electric Corp., Lighting	1A
R. & W. Wiley Inc.	24A

Specify

MITCHELL

the finest in fluorescent for every commercial, industrial and institutional application . . .

WRITE FOR DESCRIPTIVE CATALOGS

MITCHELL manufacturing co.

2525 N. Clybourn Ave., Chicago 14, Illinois

In Canada: Mitchell Mfg. Co., Ltd., 19 Waterman Ave., Toronto

---

FOR THE MANY

WHO WANT QUALITY WITHIN REASON

Sightsaver

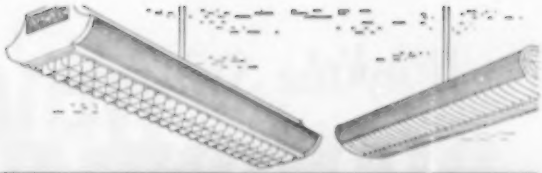
LIGHTING

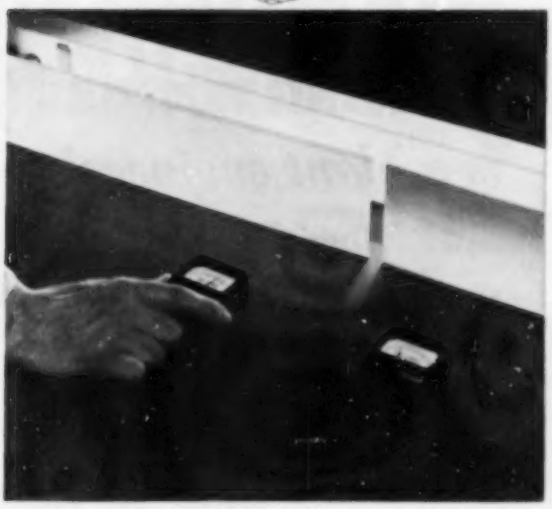
. . . for churches and institutions is designed for those who want efficient illumination and beauty at a price within their means. It is the originator of many FIRSTS in the lighting field and features R-40 reflector floods, louver bottoms and multiple circuit wiring. Special design service available.

Request catalog I on your letterhead

R.A. MANNING CO.

BOX 643 SHEBOYGAN, WIS.





LIGHT TRANSMISSION UP TO 70% SAME DIFFUSION—MADE POSSIBLE BY SHEFFIELD DEVELOPMENT

Now you can design fluorescent fixtures with polystyrene plastic shields that not only add beauty and style to the fixture, but have light transmission up to 70%.

Sheffield's new DG-70 grade, increases lighting efficiency by controlling light refraction. Shields made of DG-70 by Sheffield Plastics have good impact strength and exceptional hiding power — capable of completely hiding the light source silhouette at a 1 inch distance. Their lustrous finish and blue-white color enhance the appearance of any fixture.

DG-70 is another example of progressive engineering at Sheffield Plastics — engineering devoted to providing you with top quality, rigid extrusions incorporating the latest technical advances.

For more information or a quotation on a rigid extrusion write to Sheffield Plastics Inc., Dept. 151-2B, Sheffield, Mass.

Precision Engineered Rigid Plastic Extrusions

SHEFFIELD PLASTICS

INC.

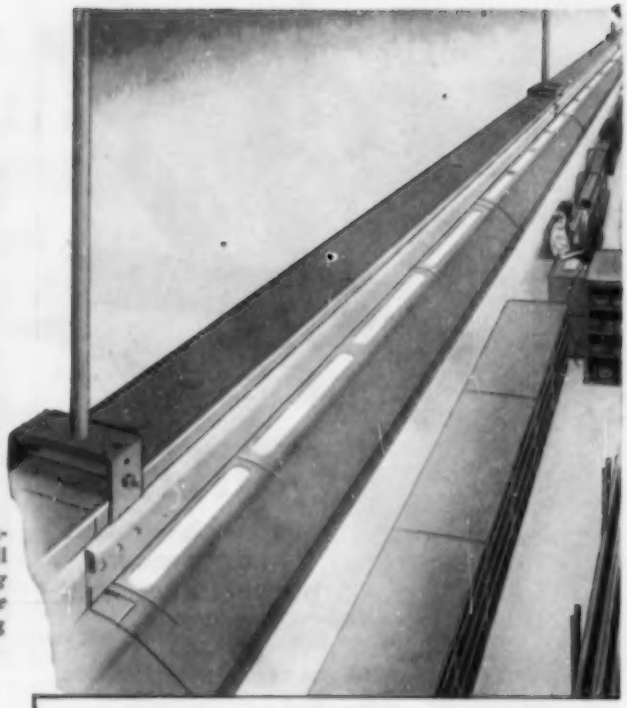
SHEFFIELD, MASS.

Why the Sylvania

DIAMOND-I

LIGHTING FIXTURE

is a plant engineer's best friend



Better Plant Illumination

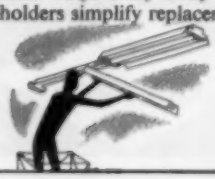
Sylvania's exciting new semi-direct fixture is taking industry by storm! Enlarged reflector slots release a full 25% of its light upward. *Result: More light on the ceiling . . . reduced contrasts overhead . . . less shadow and glare on work surfaces below!* Optimum 30° crosswise shielding protects eyes from direct glare of lamps.

Maximum Lighting Efficiency

By unleashing more light upward which would normally be "trapped" between lamp and reflector, the *Diamond-I delivers an extremely high 89% lighting efficiency!* More light on the job means better seeing and working conditions, better morale, better quality and rates of production.

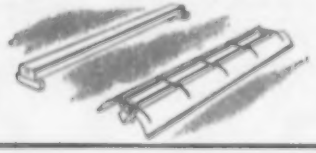
One-Man Maintenance

With 4-foot reflector-shields on both 4- and 8-foot units, one man can do it all alone! Reflector-shield is lightweight, easy to handle . . . secured to channel assembly using 2 captive bolts which can't drop out. Slots in reflector induce upward heat draft which helps carry away dust particles. Multi-socket lampholders simplify replacement.



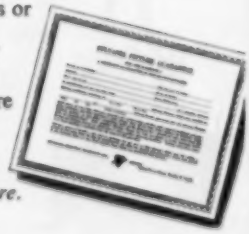
Quick and Easy to Install

Simply install the one-piece channel assembly, then fasten on the reflector-shield unit by its 2 captive bolts. Sufficient knockouts and slots in the channel assembly will accommodate all basic installation methods. Full-length grooves enable you to use slide-grip hangers.



2-year Guarantee—RLM approval

The Sylvania Diamond-I meets or exceeds all new RLM specs! Here's the industrial fixture of tomorrow, ready to be put to work for you *now*. What's more *—a replacement guarantee protects you against defective materials and workmanship for 2 years from date of manufacture.*



Send the coupon for complete specification information. ▶

SYLVANIA®

. . . fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS
TELEVISION • ATOMIC ENERGY

Sylvania Electric Products Inc.
Dept. K-30, Lighting Division—Fixtures
One 48th Street, Wheeling, West Virginia

☐ Please send your complete data folder F-692 on the "Diamond-I."

☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

Organization_____

Address_____

City_____ Zone_____ State_____

WHO makes the RLM units I need?

With the recent revisions in RLM Standards for Industrial Lighting Units, featuring new upward-component fluorescent units, it is more important than ever that you know *who* makes units which conform to these newly-established and recently-revised specifications. This chart gives you the up-to-the-minute answer. It is based on the latest report of the Electrical Testing Laboratories who continually check conformance to RLM Standards. For a complete set of RLM incandescent and fluorescent specifications, as well as the addresses of RLM Manufacturers, send for a complimentary copy of the 1955 RLM Specifications Book.

RLM Standards Institute, Suite 823, 326 W. Madison Street, Chicago 6, Illinois.

HERE is your up-to-the-minute ANSWER!

These are the MANUFACTURERS who offer RLM-LABELED UNITS

INCANDESCENT RLM SPECIFICATIONS							FLUORESCENT RLM SPECIFICATIONS										
#1	#2	#3	#4	#18	#40		TD-1	TD-2	TD-3	D-1	D-2	D-3	SD-1				
100-1000w Dome	100-1000w Deep Bowl	100-1000w Synthetic Angle	500 & 1000w High Bay	500 & 1000w Glasstrol Diffuser	200-1000w Glasstrol High Bay	300 & 1500w High Bay	2-40w & 2-38w	3-75w	2-40w	3-75w	2-40w & 2-38w	2-40w & 2-38w	3-75w	2-40w	3-75w	2-40w	2-75w
5		1		3	2	ABOLITE REFLECTOR DIV.											
4	5	2		2		APPLETON ELECTRIC CO.											
5	4	4		3		BENJAMIN ELECTRIC MFG. CO.	OC	OC	OC	OC	OC	OC	OC	OC	OC	C	C
						DAY-BRITE LIGHTING, INC.						O	O	O	O	O	O
						EASTERN FIXTURE CO., INC.	O	O	O		O						
2	4	2				ELECTRO SILV-A-KING CORP.	OC	O	OC	O	OC					O	O
						ENDER-MONARCH CORP.	O		O								C
						FLUORESCENT FIXTURES OF CALIF.	OC	O	OC	O		O	O	O	O	C	OC
						GLOBE LIGHTING PRODUCTS, INC.	OC	O	OC	O		OC	OC	OC	OC	O	O
						THE EDWIN F. GUTH CO.	O	O	O	O	O						
						KEYSTONE ELECTRIC MFG. CO.	OC	O	OC	O		O					
						LEADLIGHT FIXTURE CO.	OC	O	OC	O		O	O	O	O		
5			2	2		THE MILLER CO.	OC	O	OC	O	OC	O	O		O		
						MITCHELL MFG. CO.	O		O		O						
4			2	2	2	MULTI ELECTRIC MFG., INC.											
3	4	4				OVERBAGH & AYRES MFG. CO.											
5	4	4	2	2		QUADRANGLE MFG. CO.											
						THE RUBY LIGHTING CORP.	O	O	O	O							
						RUBY-PHILITE CORP.	OC	O	OC	O	O						
						SMITHCRAFT LIGHTING DIV.	OC	O	OC		O	O	O	O	O		
5	4	5		3		SMOOT-HOLMAN CO.	OC	O	OC	O	O	O	O	O	O	O	O
4		1				SPERO ELECTRIC CORP.											
						SUNBEAM LIGHTING CO.	O	O	O	O							
						SYLVANIA ELECTRIC PRODUCTS, INC.	OC	O	OC	O	OC	OC	O	OC	O	OC	O	O
4	2	4		1		WESTINGHOUSE ELECTRIC CORP.	OC	O	OC		O					O	O
5	4	2				WHEELER REFLECTOR CO.	OC	O	OC	O	OC	OC	O	OC	O	OC	C	C
						WORK-O-LITE CO.	O	O	O	O	O						
						ZANE MFG. CO.	O	O	O	O							

TD-1, 2, 3 – without uplight

D-1, 2, 3 – 5–15% uplight

SD-1 – 20-30% uplight

O = Open End

C = Closed End

*Aluminum Reflectors all others are Porcelain Enamel

Note: Many manufacturers make incandescent RLM Units for more than one lamp size. The numerals refer to the number of different-size RLM Units which the manufacturer offers under the specification.

LOOK FOR MANUFACTURER'S NAME AND RLM

COMPLIANCE WITH SPECIFICATIONS INSURED BY

ELECTRICAL TESTING LABORATORIES, INC.

RLM STANDARDS INSTITUTE INCORPORATED

The Letters RLM stand for Reflector and Lighting Equipment Manufacturers

make hallways say, "Come in!"

new Guth V·C·U

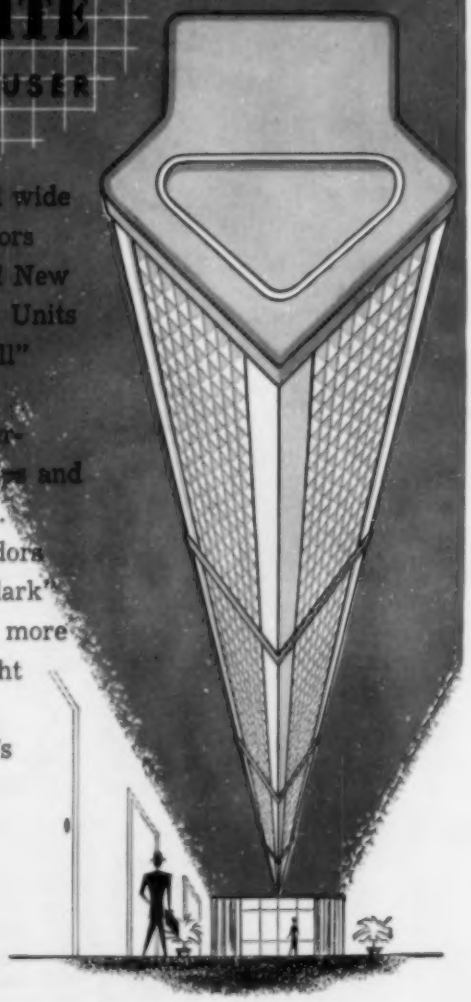
"V" CORRIDOR UNIT

with

GRATELITE*

LOUVER-DIFFUSER

At last—you can fill wide hallways and corridors with practical light! New Guth "V" Corridor Units provide "wall-to-wall" illumination. The GRATELITE Louver-Diffuser shields lamps and is easily maintained. Hallways and corridors "come out of the dark" and turn into safer, more cheerful lines of light that guide the eyes and the step. V·C·U's available in 4′ & 8′, 1 & 2 light models.



*U. S. & Can. Pats. Pend. Trademark Registered

Write today on your letterhead for complete information.

Guth

THE EDWIN F. GUTH CO. ST. LOUIS 3, MO.